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VOLUME 35 NUMBER 210 PART I

American Statistical Association

Organized November 27, 1839
Incorporated 1841

The American Statistical Association is a scientific and educational organization. Its membership is not confined to professional statisticians but includes economists, business executives, research directors, government officials, university professors, and other persons who are seriously interested in the application of statistical methods to practical problems, in the development of more useful methods, and in the improvement of basic statistical data. Engineers, mathematicians, biologists, actuaries, sociologists, psychologists, and representatives of many other professions are included in the membership of the Association. Information about the Association and membership application forms may be secured from the Secretary, Frederick F. Stephan, 1626 K Street, N.W., Washington, D. C.

The 102nd Annual Meeting of the American Statistical Association will be held in Chicago, Illinois, December 26 to 28, 1940. With a few exceptions the sessions are open to the public.

Chapters of the Association have been organized in important cities in the United States. Information concerning the meetings of these chapters may be secured from the District Representatives listed on another page.

The Editors welcome the submission of articles and notes for possible publication in the JOURNAL. Manuscripts should be sent to the Editor, Journal of the American Statistical Association, 1626 K Street, N.W., Washington, D. C. Books for review should be sent to the Review Editor, Glenn E. McLaughlin, 210 Normandy Building, 1626 K St., N. W., Washington, D. C. Authors who wish suggestions about the preparation of manuscripts and charts or information about editorial policies should address their inquiries to the Editor.

Subscription rate, $6.00 per annum. Single numbers of volumes 23 to 32, $1.50 per copy postpaid, except Proceedings Supplements to volumes 23 to 30, $2.00 per copy postpaid. Prices for sets and discounts for orders in quantity available on request.

Published Quarterly by the AMERICAN STATISTICAL ASSOCIATION
Publication Office: 450 Ahnaip Street, Menasha, Wis. Editorial Office: 1626 K Street, N.W., Washington, D.C. Acceptance for mailing at special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph 4, section 538, P. L. & R., authorized March 25, 1936. Entered as second class matter at the post office at Menasha, Wisconsin.

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

JUNE, 1940 · $1.50 PER COPY · $6.00 PER ANNUM · VOL. 35 · NO. 210, PT. 1

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PART 2

CENTENARY MEMBERSHIP DIRECTORY

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

Number 210, Pt. 1 JUNE, 1940 *Volume 35*

WAR AND COMMODITY PRICES*

By Holbrook Working
Food Research Institute, Stanford University

The historical observation that great wars have commonly been accompanied by great advances in commodity prices has perhaps fostered a mistaken impression of uniformity in the relation between wars and price advances; yet the facts admit no doubt that a significant relation exists. The irregularity of the relation between the scope, severity, and duration of war and the magnitude of the associated price advances, however, suggests the hypothesis that war has little direct effect on the general level of commodity prices, but that it creates a condition favorable to the generation of independent forces tending toward great price advances. Studies in monetary and price theory support this hypothesis.[1]

In the study of phenomena of general price change, as in other economic investigations, statistics and statistical analysis have perhaps served most frequently as an aid in exploring individual facets of the problem, more or less artificially segregated for special analysis. But statistics may serve also, and with special effectiveness, in the organization of fragmentary explanations into an integrated account of complex events. For a balanced explanation of complex economic phenomena, the several influences at work must be appraised in terms of relative importance. This requires quantitative evaluation, which is difficult or impossible without the aid of statistical measurement.

Appraisal of prospects for prices in a concrete situation calls even more strongly than explanation of past events for quantitative evaluation. Historical explanation may stop with quantitative appraisal of the relative importance of various forces as regards only their net

* Revision of a paper presented to the San Francisco Chapter of the American Statistical Association, October 26, 1939.

[1] Logically, one may say that war has no direct effect on commodity prices. But some of the necessary accompaniments of a major war tend almost inevitably toward at least some moderate general price advance, and it is convenient to regard these as effects of war, as I do in later paragraphs, recognizing that the magnitude of the effect may be modified by associated circumstances. Other price influences that may be generated—those chiefly involved in great price advances—are by no means necessary consequences of war, and it is important that their effects should not be regarded as direct effects of war. Any segregation of price influences into these two categories must be somewhat arbitrary. The distinction involved is not likely to prove serviceable for refined analysis, but it seems justifiable for the sake of brevity in a summary treatment of the subject.

effects. Judgments of prospects can not be well-founded unless they include quantitative appraisals both of the magnitude of potentially important causal influences and of the effects to be expected from such influences.

The present paper aims at no detailed analysis of the relations of cause and effect in the phenomena of general price change. Its objective is rather to throw light on the relative importance of various influences that may bear on general price levels in time of war. The history of prices in various countries during 1914–1919 may be studied with profit from this standpoint. But it is not to be casually assumed that price developments in the present war will closely parallel those of the last great war. In the final section below, some pertinent differences between circumstances in the two instances are considered.

I. PRICE THEORIES TO BE DISCARDED

The interpretations on subsequent pages reflect acceptance of certain theories of the general price level and of related economic influences. No attempt is made to state grounds for such acceptance. The interpretations reflect also non-acceptance of certain other theories, and these call for some preliminary comment. One of the more or less prevalent views which we do not accept is that which assumes that there is a simple direct connection between war and the great price advances that have sometimes been associated with war. This view requires no criticism beyond that suggested in the opening paragraph above. Two other theories deserve more extended notice: that which views heavy governmental borrowing as a direct cause of price inflation, and the "absolute-value" theory of prices.

The view that heavy governmental borrowing is directly inflationary seems to rest heavily on the reasoning that large flotations of bonds involve expansion of credit and that credit expansion tends to induce price advances. This reasoning fails to discriminate among different forms of credit expansion. Extension of credit by individuals through the purchase of bonds is in fact very different from extension of credit by commercial banks. The two generally differ in their effects on the volume of circulating medium; they generally differ in their effects on the aggregate purchasing power of the community; and they generally differ in their effects on the distribution of purchasing power among economic classes.

There is at least one sound basis, however, for arguing that excessive governmental borrowing does tend to generate great price advances. Excessive governmental borrowing, long continued, may undermine the fiscal position of the government and lead to resort to issues of in-

convertible paper money, or to excessive governmental borrowing from banks. These in turn may induce large price advances. Carried far enough, governmental borrowing may shake confidence in the ability of the government to meet its obligations. When such a stage is reached there is likely to be little currency in circulation except such as depends for its value on confidence in the government, and as confidence wanes, the value of the currency tends to depreciate.[2]

It is apparent, however, that this argument does not treat governmental borrowing as a direct cause of price inflation. It presents governmental borrowing in excess as tending toward consequences which in their turn tend toward price advances. This distinction is important from the standpoint of timing of cause and effect. On this reasoning, heavy borrowing may continue for a long time before the secondary price effect is experienced. The distinction is important also from the standpoint of the confidence with which the expected effect may be anticipated. Borrowing that appears excessive may be diminished before the critical point is actually reached. Or it may be that the secondary effect to be expected nowadays is not that which has often been observed historically. Perhaps now we should reason, not that excessive borrowing tends toward fiscal difficulties and inflation, but that it tends toward dictatorship, and toward capital levies, repudiation, or other devices for circumventing the fiscal difficulties.

Certain interpretations of the general price level that have exercised much influence on economic thought have as their distinguishing feature the concept of value as something that is absolute. To one who holds this concept, it appears reasonable to compare two periods of declining prices, for example, and to say that in one of them the general price level fell because the value of money rose, while in the other, the value of money remained constant but the values of most commodities fell. Thus, one who holds this concept can argue with great feeling the question whether a general change in prices was due to a change in the value of money or to a general change in the value of commodities.

The objection that is most commonly made against this theory is a philosophical one, namely, that value is purely relative. If value is purely relative, the value of money has no meaning except as it is expressed as the reciprocal of the price of some commodity or group of commodities, and the value of commodities in general has no meaning

[2] With the experience of the last great war in mind, I am concerned in this paper chiefly with influences which might induce price changes of such magnitude as those associated with that war. If interest were centered on possibilities of price changes of a considerably lower order of magnitude, attention might be directed primarily to circumstances surrounding the spending by the government of the proceeds of its borrowing.

except as it is expressed in terms of some common medium of exchange. If value is purely relative, then, any general change in prices may be described with equal validity either as reflecting a change in the value of money or as reflecting a general change in the values of commodities. Argument as to which was the cause of the general price change simply fails to make sense.

This objection to the absolute-value theory of prices seems to me wholly sound, but another objection may be more convincing. The absolute-value theory proceeds from the view that money has a value which is subject to change independently of changes in the values of commodities, and that each commodity has a value which is subject to change independently of changes in the value of money, and reasons that price is the expression of the relations of these values. It interprets the price-making process as merely one in which the value of money is weighed against the value of a commodity. To one who has studied closely the processes of price determination for individual commodities, this appears an unrealistic concept, valid only to a limited extent under peculiar conditions. I am unable to place confidence in conclusions founded on such a mistaken premise.

II. GENERAL PRICE INFLUENCES, 1914–1919

The price advances of the last great war are commonly regarded as primarily monetary phenomena. There were other important influences at work, however, and in the present war such other influences may not be so dwarfed in relative importance as before by the effects of monetary influences. In reviewing price developments of 1914–1919 it is well to look first at evidence of influences that were not primarily monetary in origin.

Evidence of these other influences, and some indication of the magnitude of their effects, may be gained from comparisons of price changes in different countries. In this comparison, emphasis will fall on *differences* between price movements in different countries as shown by index numbers. Here, as often, the study of differences between price changes will be found a useful analytical procedure.[3] When we observe price movements differing significantly between two different countries we shall hesitate to explain them in terms of influences which must be considered to have had about equal force in the two countries. We shall be led to look for special influences operating in one country or in the other. When we find price movements corresponding closely in two countries we shall hesitate to account for them in terms

[3] Since the charts to be used are drawn to semi-logarithmic scales, the differences reflected graphically are percentage differences.

of influences which must be supposed to have had quite different force in the two countries. In short, considering differences (and similarities) between price movements in different countries makes it possible to bring quantitative considerations to bear on the analysis. The quantitative analysis, though rough, helps toward avoiding errors in conclusions and toward discovering significant influences that might otherwise be overlooked. It has also the advantage, from the standpoint of appraising prospects for the future, that it gives an impression of the relative magnitude of potential effects of different price influences.

For international comparisons it is advantageous to use index numbers of identical or closely similar constitution, both as to commodities used and as to weighting. The requirements are well met by index numbers of prices of 40 basic commodities published by Warren and Pearson.[4] All the subsequent comparisons are based on these index numbers, which are computed for all countries from quotations for the same 40 commodities, identically weighted. The commodities may be described as falling into the following five groups or combinations of groups of about equal weight in the index number: (1) grains; (2) livestock and livestock products; (3) textiles, and foods not represented in the previous groups; (4) fuels and metals; and (5) miscellaneous (lumber, newsprint paper, and hides carry two-thirds of the weight of this group). The index numbers are published both in terms of actual quoted prices in the currency of the country and in terms of prices expressed in gold. Both the index numbers in terms of currency and the index numbers in terms of gold are useful for our comparisons.[5]

Prices in Germany. Sharp sustained advances in prices after the outbreak of war in 1914 occurred sooner in Gemany than in any other country which we can bring under consideration (Chart I). The note issue in Germany, and loans and discounts in German banks, more

[4] In *World Prices and the Building Industry* (New York, 1937).

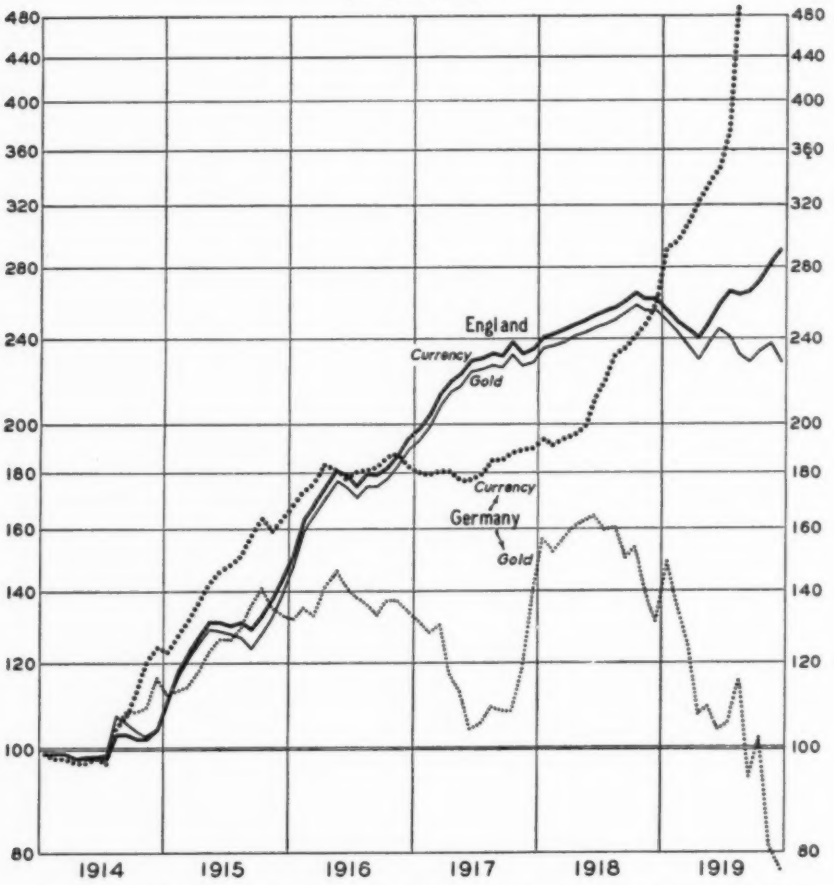
[5] Warren and Pearson's index for English prices in terms of gold prior to September 1919 is identical with their index of English prices in currency. It seems to me improper thus to neglect the fact of depreciation of the pound after the early months of the World War, even though the clearly measurable depreciation was small. In terms of dollars, the pound sterling rose in value immediately after the outbreak of war and then depreciated from its par of $4.8665 to an average of $4.67 for the month of October 1915, and from early in 1916 to March 1919 was pegged at $4.76–$4.77—about 2 per cent below par. For the accompanying charts I have derived the index of English prices in gold from Warren and Pearson's index of prices in currency by adjustment on the basis of the dollar-sterling rate of exchange (exchange rates from *Handbook of Foreign Currency and Exchange*, U. S. Department of Commerce, Trade Promotion Series, No. 102, 1930, p. 174).

As will be remarked below, the pound seems to have depreciated more in gold value during the World War than is indicated by the controlled rates of exchange against the dollar; but it seems better to use this possibly defective basis for expressing the English index of prices in terms of gold than to treat the English prices as having actually remained on a gold basis until September 1919. The method which I thus employ in the case of the English index number is, moreover, the same that Warren and Pearson use for converting the index numbers of prices in other countries to a gold basis.

than doubled within a few months after the outbreak of war, but thereafter they were allowed to increase at only a moderate rate until after the middle of 1918.[6] If expansion of domestic credit and currency was a

CHART I

INDEXES OF WHOLESALE PRICES IN GERMANY AND ENGLAND, MONTHLY, 1914–1919*
(1910–1914 = 100)



* Indexes of prices of 40 basic commodities, from G. F. Warren and F. A. Pearson, *World Prices and the Building Industry* (New York, 1937), except English prices in gold, on which see footnote 5, p. 313.

major factor in the German price advance, it was one that acted slowly, for 12 months after the outbreak of war the German price index number (in currency) had risen only 50 per cent. In the first 5 months of

[6] U. S. Senate Commission of Gold and Silver Inquiry, Serial 9, Vol. I, *European Currency and Finance*, by John Parke Young (Washington, 1925), p. 397.

war, however, the German index number rose 27 per cent while the British index rose only 6 per cent. This first sharp advance in German prices was mainly a result of almost immediate shortage in supplies of many commodities in consequence of the Allied blockade of Germany. Requisitioning of supplies for the army aggravated the shortage. Depreciation of the German mark, directly affecting price relations of such goods as moved in international trade, soon contributed to the price advance.

Beginning in late 1915, after a little more than a year of war, the course of German prices diverged sharply from that of prices in other major European countries. The divergence is most conspicuous in terms of prices expressed in gold, for the rate of advance of German prices diminished in the winter of 1915–16 just at the time that the German currency was depreciating rapidly in foreign exchange; but from late 1915, at least, the nominal gold equivalents of German prices have little significance.

Between October 1915 and April 1916 the index of German prices, in marks, rose from 163 to 183. This was an advance of 12 per cent in six months, but it appears relatively small when compared with advances in other countries as follows:

	Index number (1910–1914 = 100)		Percentage increase
	Oct. 1915	April 1916	
Germany	163	183	12
England	133	174	31
Italy	162	217	34
United States	106	126	19

During the next two years, April 1916 to April 1918, German prices changed little, while prices in other countries increased greatly. The changes, in terms of currency, compare as follows:

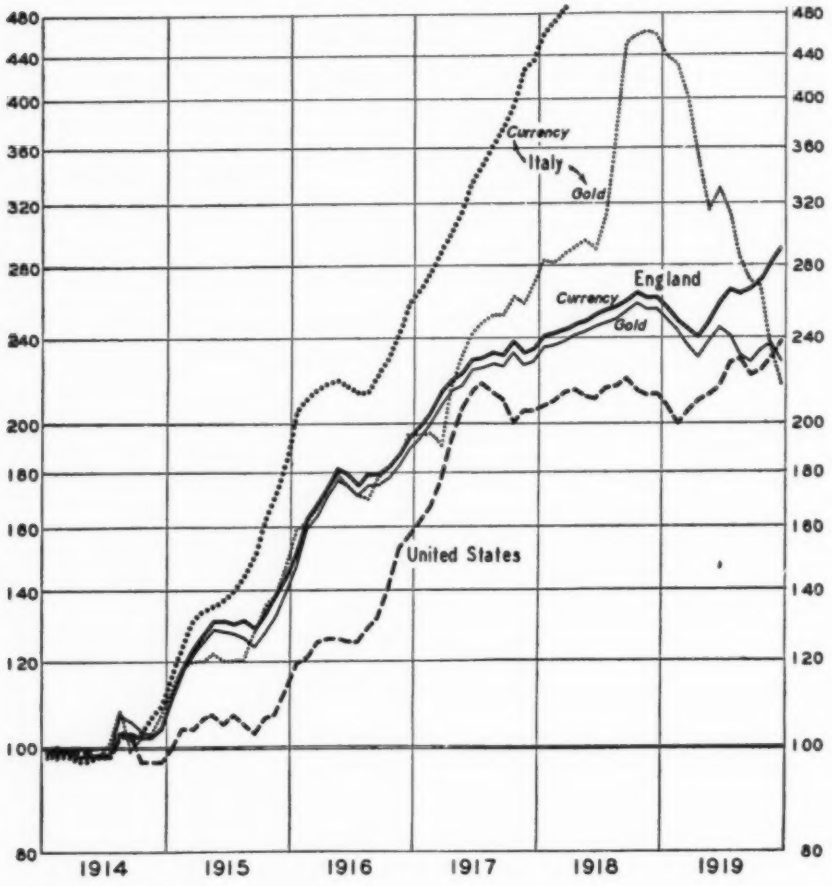
	Index number (1910–1914 = 100)			Percentage increase
	April 1916	April 1917	April 1918	1916–1918
Germany	183	180	195	7
England	174	219	247	42
Italy	217	299	494	128
United States	126	192	214	70

This remarkable stabilization of German prices while prices in other countries were skyrocketing, and while Germany was suffering more severe shortage of materials than the other countries, was a consequence of governmental regulation of prices and wages, with the neces-

sary accompaniments of rationing and regulation of production. Through two years of extreme stress these controls held prices steady. Only as the German economic system began to totter and German morale to crack in the spring of 1918 did prices start to rise out of control.

CHART II

INDEXES OF WHOLESALE PRICES IN ITALY, ENGLAND, AND THE UNITED STATES, MONTHLY, 1914-1919*
(1910-1914 = 100)



* Data as for Chart I.

Prices in England and Italy. The index numbers of quoted prices in Italy and England (Chart II) begin to diverge only a few months after the outbreak of war, owing to depreciation of the lira. When the index numbers are converted to a gold basis, however, the Italian and English indexes generally correspond closely until the spring of 1917. The

closeness of correspondence of these two index numbers is perhaps partly fortuitous, but broadly it is what might be expected in two countries similarly situated in relation to world markets, both heavily dependent on imports, and with prices free to move without important governmental interference.

During this period of generally close correspondence between English and Italian prices, from the outbreak of war to early 1917, there was one interval of disparity that may warrant more than casual mention. In Italy the price advance of the winter of 1914–15 was only about two-thirds as great, in terms of gold, as the corresponding price advance in England, and during February–August the Italian index number, in gold, was stable at a level about 6 per cent lower than the similarly stable level reached by the English index number in April. The fact that England was at war and Italy not during the winter of 1914–15 may account for the difference between price advances in the two countries at that time.[7]

From early 1917 the English price index number reflects the restraining influence of governmental price controls, first rather ineffectually applied late in 1916, and then with greater force and effectiveness in 1917. Important price controls were applied in England about a year later than in Germany, and not so vigorously and generally. In England the general price advance was not stopped, but the rate of advance was so moderated as to leave no doubt of the potency of the English controls.

The United States and England. The curves of the price indexes for the United States and England diverge strongly, yet there appears a noteworthy resemblance between them. In both countries general price advances were delayed until about the end of 1914. In both countries prices as represented by the basic-commodity index numbers slightly more than doubled during the next 2½ years. And in both countries the advance was accomplished in three spurts, separated by intervals of 4 months or more of approximate stability in the level of prices. In England prices advanced about 30 per cent in the first and last of these three spurts, and a little more in the middle one. In the United States the first sustained upward movement was scarcely a spurt. It was rather a weak halting movement that carried prices upward a bare 10 per cent. The next move was much more vigorous and decisive—prices advanced 20 per cent in four months. On the third movement prices fairly took wings, and mounted by a full 70 per cent in a swift upward drive.

A considerable part of the divergence between the British and the

[7] Italy, it will be recalled, was not forced into the war until May, 1915.

American index numbers during 1915 and 1916 can be explained as an effect of high ocean freight rates. A considerable number of the commodities included in the 40-commodity index were being exported in substantial volume from the United States to England. Increases in ocean freights tended either to raise the prices of such commodities in England or to depress their prices in the United States, or to do both. The magnitude of this effect may be illustrated by ocean freights on grains. Just before the outbreak of war in 1914, the ocean freight rate from North Atlantic ports to the United Kingdom was 2 shillings per quarter, equivalent to about 6 cents per bushel. During the previous spring the rate had been as low as $5\frac{1}{4}$ cents. By early December 1914 the freight rate had doubled as compared with the rate in July 1914. By March 1915 it had doubled again. During the autumn of 1915 it increased over 50 per cent to more than 6 times the prewar rate and during 1916 averaged over 6 times the prewar rate, or about 40 cents per bushel. During 1917 the rate was generally about 15 times the prewar rate, and during 1918, generally 25 times the prewar rate.

The advance in ocean freights added about 10 per cent to the cost of American wheat landed in England in 1915. It added about 15–20 per cent to the cost of American wheat landed in England in 1916. Freights represent a larger percentage of the import price for some commodities than they do for wheat, while for many other commodities they represent a smaller part. If it be assumed that the advance in freight rates affected prices of other commodities in the 40-commodity index by the same percentage, on the average, as it affected wheat, the advance in ocean freights appears adequate to explain only about half of the discrepancy between the English and the United States index numbers in 1915 and 1916. Probably in fact the advance in freight rates explains considerably less than half of the discrepancy between the American and English index numbers in these years.[8]

The large discrepancies between the index numbers for England (in gold) and the United States, amounting to about 20 per cent in the summer of 1915 and 40 per cent in the summer of 1916, must be explained in considerable part by effects on commodity demand and supply that were more or less peculiar to a country engaged in a major war. A suggestion of the existence of such influences has already been noted in the relations between English and Italian prices in 1915. Even in a list of 40 commodities that move actively in international trade

[8] For some commodities imported by both England and the United States, the advance in ocean freight rates presumably had little effect on price relations between the two countries.

In the present war, the advance in freight rates has been much more rapid than in the previous one. Starting at 8 cents per bushel just before this war, the rate on wheat from North Atlantic ports to Antwerp advanced within six months to over 50 cents per bushel.

there are a number which could have their prices in England affected much more than prices in the United States, even in the absence of increases in costs of ocean transportation. Prices in England of livestock and livestock products, and of some of the grains, felt especially the effects of curtailment of British production and of some increase in demand; and prices of coal and iron and of their products in England were influenced by a great increase in English demand.

After late 1916, and more particularly after early 1917, various governmental controls restrained advancing tendencies in British prices, as already noted. Some of the controls merely set maximum prices and margins, and thus limited the profits of domestic producers and of merchants. Some of the controls involved purchase of imported commodities for government account and resale at a loss to the government. Some of the controls involved governmental subsidy of the industry, so that quoted prices ceased to have the meaning usually attaching to them in a competitive price economy.

In the United States a long list of price controls were instituted, beginning in August 1917. The decline in the index number for the United States between July and October 1917 was probably attributable mainly to these controls, but partly to a natural reaction of a considerable number of commodity prices from previous speculative price advances. Governmental controls probably were chiefly instrumental in preventing significant advance in the 40-commodity index of prices in the United States during our participation in the war.

The continued disparity between prices in terms of gold in England and prices in the United States after the latter entered the war deserves notice. This disparity persisted with little change for nearly a year after the war ended, and then disappeared quickly when the control of sterling exchange was relaxed (Chart II). Clearly much at least of the disparity which had existed for a considerable time was such as could be maintained only through governmental restrictions on trade and on transfers of foreign exchange. One may infer that, whatever the initial cause of the price disparity that developed between these two countries as early as 1915, its continuance was in large part dependent on such governmental restrictions. In the presence of such restrictions, prices in different countries may not be directly comparable even when reduced to a nominal gold basis.[9]

This comparison of the course of prices in England and the United

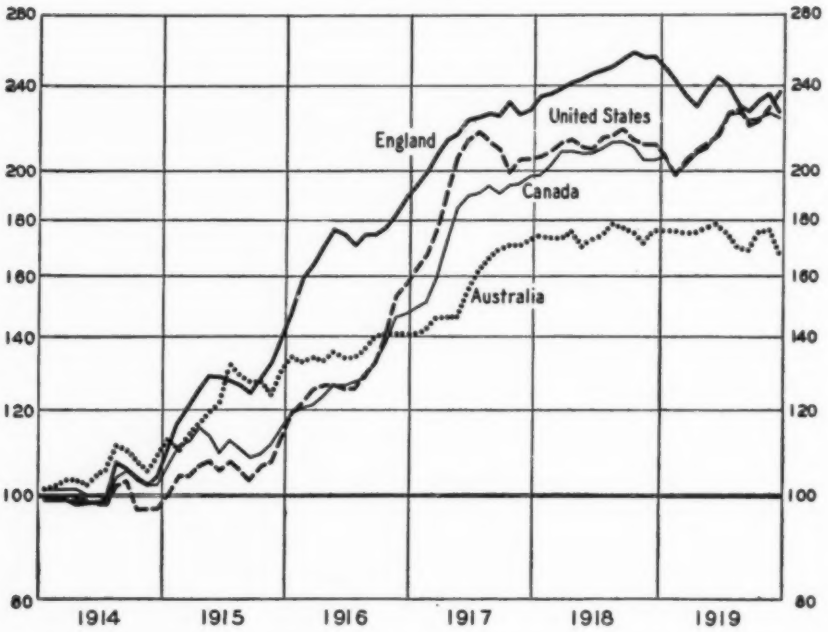
[9] German prices, thus reduced, have so little significance after 1915 that no notice was paid them in the discussion above. The qualification here suggested with respect to English prices, quoted in a currency nominally on a gold basis throughout the war, might well be taken into account in consideration of the relation between English and Italian prices; but that can not be undertaken here.

States leads to emphasis again on the potential influence of governmental controls in determining the level and course of wholesale prices. The new points that it brings out are the effects of great changes in costs of ocean transportation and the influences of demand-and-supply conditions more or less peculiar to a country engaged in a major war.

Australia and the United States. It is logical to suppose that the effect of greatly increased costs of transport should show more clearly in a

CHART III

INDEXES OF WHOLESALE PRICES IN AUSTRALIA, CANADA, ENGLAND, AND THE UNITED STATES, IN GOLD, MONTHLY, 1914–1919*
(1910–1914 = 100)



* Data as for Chart I.

comparison of prices in Australia with those in England than in the comparison between the United States and England (Chart III). The statistics for 1917 and later years accord with this expectation, but the course of the Australian index number during the early part of the war seems contradictory. This fact gains added importance from the conclusions drawn by Wesley C. Mitchell. In his *History of Prices during the War—International Price Comparisons,* Mitchell says: "Far away as is Australia from the main seat of war, her heavy contributions in

both men and supplies sent prices up in the autumn of 1914 as promptly as they rose in England."[10]

I venture, however, to suggest that Mitchell drew his conclusion too hastily. One may hold this without implying lack of reasonable care on his part, for the amount of work that fell on Professor Mitchell in connection with preparation of the *History of Prices* in the space of a few brief months may make one marvel that the errors are so few. Mitchell in this case appears to have overlooked the consequences of the great Australian drought of 1914. The Australian wheat crop harvested near the end of 1914 was inadequate for home needs, and Australia became a net importer of wheat during the calendar year 1915 instead of a heavy exporter, as usual. Other agricultural products were more or less similarly affected. As Mitchell says, without appreciating the full significance of the observation: "There was an exceptionally great rise in the price of meats and agricultural produce" in Australia in 1915.

To verify the hypothesis that the advance of prices in Australia to the autumn of 1915 might depend no more on influences connected with war than did the moderate advance in the United States I have compared the price movements in Australia and in the United States commodity by commodity for 25 of the 40 commodities included in the indexes here under comparison. If one excepts from the comparison the products of Australian farms and ranges, the price changes in Australia and in the United States are generally quite similar. Where they differ, Australia sometimes shows the smaller rise, sometimes the greater. Even among agricultural commodities, there were some such as hides and wool of which Australia had a surplus despite the drought, and the prices of these either changed about as did corresponding prices in the United States or rose less.

Perhaps the most noteworthy conclusion to be drawn from examination of the Australian data is that weather, through its effect on supplies, may have a significant effect on the course of a fairly comprehensive index number, and in extreme cases, a pronounced effect.

Canadian prices. Special interest attaches to a comparison of prices in Canada with prices in England and in the United States, using index numbers comprising the same commodities and with the same weighting in all three countries. Here is a country in a geographical position similar to that of the United States, but a member of the British Empire, and an active participant in the war from its outset.

The index numbers (Chart III) suggest that in the autumn and winter of 1914–15 the fact that Canada was at war while the United States

[10] War Industries Board Price Bulletin No. 2 (Washington, 1919), p. 38.

was not had a significant effect on the comparative levels of prices. But this effect was transitory. Canadian prices soon fell into line again with those in the United States. In the winter of 1916–17 prices in Canada and the United States again diverged, this time with Canadian prices rising less than those in the United States; but in this instance, as in the earlier one, the course of Canadian prices somewhat resembled that of English prices. The British efforts at price control that moderated the advance of English prices during the winter of 1916–17 apparently tended also to restrain price advances in Canada.

Monetary influences. It seems permissible here to touch only lightly the relation of monetary phenomena to price changes during the last war. To deal thoroughly with the subject would extend this paper far beyond reasonable bounds. The monetary influences, moreover, have received such frequent and extended consideration during recent years as to need no further emphasis here. It suffices at this point to make a few observations on the relative importance of monetary influences in determining price changes during the last war.

In the extreme war and postwar price increases that occurred in France and Italy, and especially in such fantastic increases as eventually developed in Germany, monetary inflation may be counted the direct cause of most of the general price advance. In the comparatively moderate price increases that occurred in countries that remained on a free gold standard or close to it, appraisal of the relative importance of monetary influences is not so simple. As regards developments in the United States, for example, it may be argued with much force that the price increases originated from non-monetary influences, and that the attendant increases in circulating medium—chiefly bank credit—came as a consequence. On the other hand, quite as good a case can be made for the contention that without expansion of the circulating medium, price increases must have been held within relatively narrow limits, and that therefore monetary inflation was the principal factor in determining the amount of the general price increase.

This conflict of views arises, it seems to me, from the fact that monetary influences are not coordinate with most of the other major influences that bear on prices. Favorable monetary circumstances, I would suggest, are an essential condition for a major general price advance, but other factors may be, and usually are, the major direct causes of such a price advance.[11] Except in such circumstances as are involved when a government resorts to the printing presses for govern-

[11] With the experience of recent years to bear witness, it seems unnecessary now to support the contention that the possibility of great expansion of credit is not sufficient by itself to cause a general advance of prices.

mental financing, an attempt to attribute one fraction of a price advance to monetary influences and the remainder to other influences is much like an attempt to account for the speed of an automobile partly by the power of its motor and partly by the actions of the driver.

III. Circumstances Bearing on Present Price Prospects

With the currencies of all the present belligerent countries only loosely tied to gold and under the management of governmental agencies, it is not to be assumed that prices in any belligerent country during the present war will correspond closely to the course of prices in the United States. Rates of exchange against the dollar may be substantially altered, and the rates maintained under governmental exchange controls are likely not to reflect accurately the relative values of the currencies in their respective domestic markets.

The major belligerent countries, applying lessons learned in the last war, have employed from the outset in this, various direct price and industry controls. It seems reasonable to assume that none of the belligerent countries will allow price advances to go to such extremes as in the last war, unless it be in the late stages of the struggle when economic or political collapse impends.

Proceeding on the assumption that the United States will not be drawn into the war, it may be supposed that direct controls of prices of individual commodities in this country will be resorted to sparingly if at all.

Two circumstances hold possibilities for the United States of an even greater and more rapid price advance than in the last great war. The monetary stock of gold and silver in the United States, likely to increase further, would admit of an enormous credit expansion; and the present widespread expectation of great price advances, quite unlike expectations in the early months of the last war, would require only moderate encouragement to lead to new waves of speculative buying of commodities that would tend to raise prices rapidly.

But there seems lacking in the outlook for the United States, prospect for development of strong direct forces that would tend to raise prices. The speculative urge to acquire commodities in anticipation of a great price advance exerted its initial effect in the early weeks of the war. New upward impetus from speculative buying is not likely to appear unless prices receive added support of a more durable nature from other sources. The strongest pressure currently being exerted toward price advances is that bearing on and through wage rates, and this pressure seems at least not to be increasing.

In the sector of raw materials prices, there are some that have been

increased, and may be increased more, through advances in ocean freights. But in general there is a plethora of raw materials in the world, which promises not to be greatly modified by developments associated with the war. Vagaries of the weather may considerably modify this situation in coming months, as they have substantially reduced the outlook for next year's world wheat supplies in the months since the war began, but the extent and direction of influences of this sort seem unpredictable. Currently, raw materials prices are generally not in a strong position.

Nor is there now in evidence a pronounced tendency toward advances in prices of manufactured goods. Such a tendency, except as it be merely a reflection of advances in prices of raw materials, seems to depend for its emergence on a high level of business activity and a consequent narrow margin of reserves of unemployed labor and unused plant capacity. Orders from belligerent countries for materials of war may give a greater stimulus to American business in coming months than they have yet, but current restrictions on the granting of credit to belligerent countries and the prevailing sentiment against relaxation of these restrictions stand in the way of recurrence of such a war boom as the United States experienced in 1915 and 1916.

In the foregoing analysis of price developments associated with the last war, and in these closing observations on pertinent circumstances of the present, the emphasis has been on price influences other than those associated with money and credit. The effort has been to treat recognized price influences in due perspective, and it appears to me that in considering price prospects for the visible future—which is to say, the relatively near future—potential monetary influences may be left practically out of sight. In the longer view such is not the case. Though it be argued with considerable confidence that the forces to generate a major advance in commodity prices are not present in the existing economic setting, it may be taken for granted that such forces will at some time emerge. When they do, effective monetary and credit controls will be the only alternative to economic regimentation as a means of avoiding tremendous price advances. It would be a grave misfortune if absence of an imminent threat of inflation should retard the preparation of defenses against a danger that must eventually be faced, and that is likely to strike, when it does, with little warning.

SAMPLING PUBLIC OPINION*

By Elmo Roper
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With public opinion polls and the whole science of sampling public opinion coming in for an increasing amount of discussion, and some condemnation, I suppose the first question which might occur to anyone not actually engaged in the profession is: Why was it ever necessary or desirable to develop a technique the use of which would make possible the sampling of public opinion?

The sampling method itself has been in use for a long time and has been found to be a reasonably accurate and satisfactory method of determining the nature or value of the whole which was to be measured. It was found long ago that the judicious sampling of a car of ore would determine within reasonable limits of error the value of the entire car of ore. Wheat and other grains have similarly been sampled for years. The mathematicians have worked out some interesting formulae regarding the laws of chance and probability. Since people have probably been asking themselves and others, from the first moment of recorded history, "I wonder what's going to happen next?" it was inevitable that sooner or later there would be a scientific effort made to find out from the force which causes things to happen, the people themselves, what they proposed to do.

Without going too far back into history, it is probably safe to say that the advertising men, regardless of what other sins they may have been guilty of, are to be credited with, unless you would prefer to say blamed for, the early development of the technique which has been evolved for sampling public opinion.

A question which has always been asked by manufacturers of products, whenever there were signs that the public was exercising its inalienable right to refuse to purchase, has been. "Why isn't the public buying my goods?" Was it because of a general shift in use habits, such as the shift from the horse and buggy to the automobile—which type of shift would carry with it a serious warning as to the future of the industry itself—or was the reason perhaps that the manufacturer's goods were regarded by the public as inferior in some respects to those made by a competitor?

It was found by experiment that if one could determine what constituted a proper cross-section of the public and if one were shrewd enough to figure out what questions to ask the public, the people

* A paper presented at the 101st Annual Meeting of the American Statistical Association, Philadelphia, December 28, 1939.

themselves were perfectly willing to tell why they were not buying the manufacturer's goods in the kind of quantities which might make him happy.

It was inevitable that some impatient soul would sooner or later want advance information on which candidate the people expected to vote for, which planks they would like to see in a platform, and what decisions they would like to see made on important issues. Thus was the current public opinion poll born.

The questions which present themselves for solution in connection with the development of a satisfactory technique for sampling public opinion are simple in nature even though the solution of them didn't prove to be so simple. Those questions are three in number:

1. How can one be sure that he can select a sample of the population which will be truly representative of the entire population?
2. How can one ask the kind of questions which will let the public thoroughly understand what is wanted so they can give answers that mean something?
3. How can the actual field work best be done?

Let us analyze just what is the problem as regards the selection of the sample. Our purpose is to set up an America in microcosm. We want to have each constituent element of the entire population represented in its proper proportion in the sample.

Obviously then, one of the first considerations has to do with geography. Each census area, each economic unit of the country, must be represented in its proper proportions. If 3 per cent of our total population live in the mountain states, then 3 per cent of our sample must come from the mountain states. I think it is fairly obvious why this control is needed. One effective illustration of its need is the fact that we have found that any questions dealing with Japan or the Japanese get a different kind of an answer on the West Coast than they get elsewhere in the country. If the West Coast, therefore, was disproportionately represented, our results would be inaccurate as a reflection of the feelings of the nation as a whole.

The second important consideration in the selection of the sample is the size of place. If 10.3 per cent of our people live in cities from 25,000 to 100,000, then we must take 10.3 per cent of our sample from cities of that size. An illustration of the importance of this size of place breakdown can be found in the answers to all questions having to do with agriculture, or the agricultural problem, and the difference with which the citizens of the large cities view the solution of these problems as opposed to the way the farmers themselves or the small-town residents view them.

The third important control is sex. We need both men and women represented in their proper porportions in the sample because there are certain subjects on which they think quite differently. For one thing, many women are apt to feel that certain subjects are peculiarly "men's subjects" and, therefore, they prefer not to express an opinion but to insist that their answers be recorded in the "don't know" column. Furthermore, we have found that on many issues women are less apt to go for the extreme viewpoint than are men, and are more content to select a moderate statement as being closest to their own viewpoint.

The fourth important control is the age of the people constituting our sample. Which age breakdowns will show the most significant results is dependent somewhat on the nature of the subject under exploration, but for many subjects we have found that the age of forty seems to be a good dividing line. The people over forty are more conservative, less apt to look with favor on a new idea or an innovation, and are usually found either more reconciled to their fate in life or more apt to express their irritation at life in railing at the sexual or drinking habits of the young than in railing at any real or fancied inequalities in our economic system.

The fifth important control is the occupation of the people constituting the sample. If lawyers constitute less than 1 per cent of the total population of the country, we must be careful that lawyers do not run to 10 per cent in our sample just because they are easy to interview and often (but not always) have interesting ideas.

Sixth and by all odds the most important single control is that of economic levels. The experts are not agreed as to how economic levels ought to be defined. Perhaps this is simply because of the normal tendency of experts to disagree, but it is probably at least partly caused by the difficulties inherent in the question itself. A $4,000 annual income for a shoe dealer who lives in Dubuque, Iowa, and has no children, puts him in a certain walk of life in Dubuque. Give that same income to an assistant sales manager who has to live in New York City and support four daughters of school age and you find that he is not in the same economic stratum as the Dubuque shoe dealer, nor does he think he is, nor does he vote and act like that man on many important subjects. We have consequently concluded to base our own estimates on a combination of factors which take into account the geographical variations in average income as well as the size of place variations in average income.

With these six controls as the yardstick by which we determine our sample, we find we are able then to check on the accuracy of the sample by several devices. If the people in our sample do not report that they

own their homes in approximately the same ratio as the United States census figures show Americans generally to own their homes, or if they don't have the right percentage of telephones or electricity meters, or if the percentage of 1936 Ford cars is high or low as compared to national registration figures, we known that our sample is open to the charge of being unrepresentative to that extent. If, however, with a fair knowledge of economic and geographical variations we have carefully considered all of the yardsticks I have mentioned and if we then find, following the field work, that the sample measures up to par on these various items of checking data, I think we are warranted in feeling sure that we have in fact selected for interviewing an America in microcosm.

Now let us turn to the second important problem which presents itself. What questions shall we ask the people and how shall they be phrased so that their meaning is perfectly clear and so that in no way does the person of weak convictions get induced to answer in such a way as to brand him as being "on the right side." The first problem obviously is to agree on what broad topics one wants to explore and the second problem is to determine what questions should be asked, in what order they should be asked, and how they should be worded. I understand there are some people who take the position that all one needs in order to properly word a question is a thoroughly-trained "psychological viewpoint." Not having that thoroughly-trained psychological viewpoint, I have found it impossible to properly frame a questionnaire at the desk. One must, of course, make a start by writing a question which seems to simply and clearly convey our meaning and in such terms as avoid in so far as possible any leading words or phrases, but in the final analysis, the actual questionnaire is written in the field by a group of intelligent and skilled pre-testers who not only understand thoroughly the meaning back of the questionnaire as a whole, but have a certain acquired skill in finding words which convey the same impression to an *A* economic level doctor as they do to a *D* economic level housewife of foreign extraction. Most questionnaires we work on require the pre-testing services of three or four of these skilled people for three or four days. One questionnaire we had this summer was rewritten in its entirety fifteen times, and one question in this questionnaire was written twenty times before we felt it was ready to be printed and sent to the field.

I don't think we need labor the importance of finding the right words and phrases. Two illustrations ought to suffice. We have found that if you ask the question, "Should the United States do everything in its power to promote world peace?" you will get what is for all practical

purposes a unanimous "yes." If you change the wording to read, "Should the United States get involved in a plan to promote world peace?" you sharply reduce the number of "yes" answers. "Involved" is apparently a bad word and we should not become involved in anything, even virtue.

You would also probably get sharply varying answers if you were to ask this question in these two ways, "Would you be in favor of having Congress appropriate 25 million dollars to fight malaria?" as against, "President Roosevelt has asked Congress for 25 million dollars for the purpose of fighting malaria. Do you think he should get it?" In the second question we are, to many people, discussing more than malaria and its control. We have injected the further idea of President Roosevelt, and there are some strongly pro-Roosevelt supporters who would take the position that if Roosevelt wanted it it was probably the right thing to do. On the other hand, I regret to say that there are some so anti-Roosevelt that they would be tempted to conclude that if Mr. Roosevelt was against malaria, then malaria must indeed by a very fine thing!

Let us assume, however, that we are now satisfied that we know where to find, and have set up a sample truly representative of the country as a whole and that we have found words and phrases which clearly and without bias convey our meaning. We are still confronted with the enormous job of getting the actual field work done. I regret to say that this phase of the work has not had the consideration I feel it is entitled to. It is of at least equal importance with the other two subjects discussed. No matter how skillfully drawn the questionnaire is, it can fall down if it is sent to fifty deserving college juniors who have no feeling of the great importance of their part of the work and who have not been thoroughly trained. Our own interviewers are personally selected in their home towns by the personal interview method, either by myself or by a responsible member of our organization. The interviewer is then trained in his home community, and two years ago we adopted the policy of bringing in eight to a dozen of these interviewers on any commercial job which we happened to be doing within five hundred miles of their homes, thus giving them the further opportunity to be trained for several weeks in the field directly under us. We are often asked what kind of people make the best interviewers and find it very difficult to "type" them. They must all be honest; they must all have personalities sufficiently attractive to let them sell respondents on the idea of giving an interview; they must realize the importance of letting no inflections creep into their voice which might influence answers; and of course, they must be possessed of a good strong pair of legs! We are

materially aided, however, in our efforts to secure competent people by the fact that the work itself is extremely interesting and appeals to intellectually curious and intellectually honest people. Until last year one of our interviewers was one of Hollywood's foremost character actors who stated that our work gave him a better opportunity to study character types than anything else he did. Another was the vice-president of a nationally-known manufacturing concern who liked to spend all of his week-ends interviewing because of his genuine interest in sociology. Another is a man who lost his job during the depression and has since been ingenious enough to make a fair income out of a combination of doing work for us and selling candy which his wife makes at home. Another is a woman who is a practicing lawyer. I might go on and name a dozen others who apparently constitute different types but who have these things in common: they are genuinely interested in the work; they are honest; and they realize the extreme importance of an objective and impartial viewpoint.

When the field work is finished, the questionnaires are sent into our office where they are coded, edited, and put on punch cards for tabulation on Hollerith machines. Before they are tabulated, however, some considerable thought must be given to the question of what will be likely to prove to be significant breakdowns and significant cross-tabulations.

When the results are finally tabulated, the problem of interpretation arises, and I don't propose to take much time here in discussing interpretive methods. On the *Fortune* Survey, which we have the pleasure of doing, the interpretation is done according to the same principles of group journalism which applies to the editing of the magazine as a whole. Everyone, including myself, has a voice in the decision as to just what the tabulated answers mean.

The sampling of public opinion cannot be said to have arrived at the point where it is an exact science and where all the "bugs" have been ironed out. We have gone a long way in the last six years. Work we did then now looks pretty bad to us, and it is almost fatal to our ego to take time out to study a report we did several years ago and which we then took great pride in. Progress is being made at such a rapid rate that I have no doubt the studies we are now making will seem similarly inadequate five years hence.

Many problems remain to be solved, but two stand out prominently. We have learned a great deal about how to measure opinion quantitatively but we still have much to learn about how to make qualitative appraisals. That considerably more attention might be given profitably is indicated by the fact that our presidential forecast in 1936 was

accurate to within seven tenths of one per cent and we at no time asked the respondents for whom they intended to vote. Rather we tried to get a qualitative appraisal of the extent of feeling toward President Roosevelt and we offered the public a choice among four attitudes about him ranging from complete and unequivocal approval to thorough and annihilating disapproval. This enabled us to get a pretty accurate conception not only of which side the respondent was on but of how strongly he felt about it.

The second big problem is the necessity for further study in an effort to locate or chart all of the leading words and phrases so we can avoid them. Public opinion polls today have been criticized for the use of words and phrases which are apt to influence answers. We have come in for our share of criticism. Some of the criticism is justified, but I can't refrain from feeling that I wish our critics would place the blame where it belongs, which is on our own inadequacy of knowledge of the subject rather than to credit us with being diabolically clever and possibly dishonest manipulators.

Problems remain with the public itself. The samplers of public opinion are today credited with virtues they really haven't got and charged with vices they aren't really guilty of. Some people have leapt at the conclusion that the technique is an exact science and will inevitably predict results "on the nose," whereas most of us engaged in the work are only aiming for results which are within 3 per cent of absolute accuracy. There is much speculation as to how large the sample should be, and unfortunately, that isn't a question which can be answered categorically. The size of the sample depends on the nature of the subject and on the number of breakdowns desired. We have used from 2,500 to 10,000 in a national survey and have become convinced that if the sample is properly selected and the interviewing skillfully done, a sample of 5,000 will give results accurate within 3 per cent on most subjects.

The question arises often as to what chance there is for the polls based on scientific sampling to go wrong in predicting elections. It would be foolish to say that the possibility didn't exist. Any poll might be accurate within the limits desired by its conductor and still miss on an election of a 51–49 nature. I think we are all even more afraid, however, of an election dominated by apathy, where the people don't take the trouble to vote, and where our poll might conceivably reflect true public opinion more accurately than the election itself. The reason for this fear of apathy is our lack of a properly developed technique for qualitative appraisal.

With the approach of the 1940 elections, the fate of the *Literary*

Digest poll is fresh in the minds of certain people who are well-wishers of public opinion sampling and vice versa. I think it is safe to say that if any of the public opinion surveys which are based on scientific selection of the sample should go wrong in 1940, it will not be for the same reasons which caused the *Digest* to go wrong. Their poll was based on mail ballots and most of us in the profession knew even back in the summer of 1936 that the *Digest* would go wrong, and furthermore, we had all conducted certain experiments which let us know why it would go wrong. We found, for example, that older people answer mail ballots more readily than young people; that the prosperous and well-to-do return a great many more ballots than the poor people, and that the people with violent emotions, particularly violent emotions against whatever is going on, return mail ballots in greater percentage than do the people of more moderate sentiments. Therefore, even though the *Literary Digest* was able in some way to get its ballots to a true cross-section of the public, it was sure that a true cross-section of the public was not returning the ballots. Their returns were heavily weighted with the old who were less strongly pro-Roosevelt than the young, heavily weighted with the prosperous who were more strongly pro-Landon than the poor, and also weighted with a large return from violent critics of the administration who, feeling themselves unrepresented, wanted to cast a mail ballot or write a letter to the editor, or to something to show their disapproval.

In conclusion I should like to say just a few words about what I regard as the social significance of this technique. I think I need not caution you that I speak from a biased viewpoint, but I wish I had the time to develop fully my contention that public opinion surveys are one of the greatest contributions to democracy in the last fifty years. No longer need honest legislators be in doubt as to what the people want. No longer need they fear the results of not yielding to the pressure of a vocal minority group. Nor is there any good excuse for them to become rubber stamps for majority opinion, because in the *Fortune* Survey for November, 1938, the public itself went on record as approving of the idea of congressmen voting in accordance with their own judgment and consciences as against the blind following of majority opinion. Criticisms to the effect that public opinion surveys usurp the functions of democracy are in my opinion not only groundless, but in fact, rather stupid, assertions to the contrary by certain congressmen and newspaper columnists notwithstanding.

Business long ago learned that it could no longer expect success while dictating to the public the color or size or shape or price of those things which the public purchased. The public now makes those im-

portant decisions, and unless a manufacturer can find some way of learning what the public wants, he soon goes out of business. I should like to see the application of the principles of market research and public opinion research to government, but with no idea that they should displace the existing institutions.

Let us assume for a moment that our elected officials should give and would like to give their electorate, whether it be the electorate in a city or a state or the country as a whole, the kind of a government the electorate wants. That doesn't seem to be too unreasonable an assumption because it would be to the self-interest of the officials to do that. Perhaps we have spent too much time wailing over dishonest politicians and too little time trying to equip our elected representatives with facts as to what we the people want. If so, the problem then becomes one of devising a means by which these elected officials can learn just what the electorate does want. I contend that the ballot box cannot be depended upon as the only source of information, for the very obvious reason that little or no opportunity is given the electorate to express its opinion on the various phases of the candidate's program. Nor can a candidate learn what the majority of his constituents want by depending for his information on his political associates back home. He might with some profit read the *Fortune* Survey, but since it can hardly be considered the province of that magazine to spend its full time exploring what the people want in the way of government, and since its findings can be of little specific help to governors and mayors and councilmen and city managers, it it is obvious that something more is needed. The referendum and recall seem at first glance to be steps in that direction—but any discussion of them is a whole subject in itself, and they represent an attempt at direct government which is a different thing from what I am proposing.

I see no more drawbacks in the path of setting up a branch of government whose job it is to determine by proven methods of selective sampling what the people want than there were in the path of setting up any of the existing branches of government. I do not mean to propose that the sampling of public opinion become a government monopoly, if for no other reason than that I do not want to be forced out of the profession, and I prefer to operate as an independent. If such a branch were set up it would obviously have to be run by people with the same high ideals and sense of detached objectivity which are supposed to and in the minds of many do characterize the Supreme Court. I see no reason to suppose that a man automatically loses his integrity and his sense of objectivity when he is appointed to high office.

Such a department could act as a sounding board for the public to

inform its elected representatives more fully as to their desires than their ballot box vote could do. The public would then have an opportunity to inform its elected representative that he was elected because of the virtues of his planks 1 through 6, and despite the vices of plank 7 and thus admonish him not to regard his election as a mandate for putting this undesirable plank 7 into law. Those of you who preferred to receive your information from privately owned sources would still have, I hope, the Gallup poll and the *Fortune* Survey.

This is not an advocacy of a direct democracy, but I would like to say in closing that six years of sampling public opinion has given me a profound respect for the wisdom of the American people as a whole and with it a firm conviction that if we can keep the power in the hands of the people and further develop techniques for making them vocal, we need never have fear that this country will ever face the situations now being faced in certain countries of Europe.

PROBLEMS AND PROGRESS IN STATE STATISTICS*

By R. L. Gillett
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To exhaust this list of problems in state governmental statistics in a brief space would be impossible. To fully catalogue the progress over a long period of years would be difficult. To discuss some phases both of the problems and the progress may serve to stimulate further interest in this field that is taking on increasing importance. Among the subjects that may be mentioned are: personnel problems; coordination of work within individual state departments and between the various state departments; the relationship between the state and federal governments working in the same general field, especially with reference to coordination of statistical work between the various states and the federal government; the question of whether the states or the federal government shall supply the initiative for improving work in which both parties are interested; the use made of opportunities for research that is possible with the large amount of basic material available to the state; the possible application of this research as well as of the routine statistics in developing sound public policies; the publication of statistics in an attractive form, and distribution to the public; other similar matters would not exhaust the list of problems.

Discussion in this paper will be limited rather closely to some phases of coordination of state statistics in which our people in Albany have had aspirations, and to the field of personnel matters where we believe some real progress has been made.

Among the first interests that appealed to a group of statisticians who formed the nucleus of the Albany Chapter of the American Statistical Association ten years ago was the possibility of some type of coordination of state statistics. Practically nothing had been done in this field, although some of the statisticians had worked together informally and the field was fertile. A committee was formed. It decided that the first step was to explore the publication of statistics in the annual reports of the various state agencies in New York, and to that end cooperated with the Legislative Reference Division of the State Library in compiling the extent that statistical tables were included in the formal annual reports of the various state departments. This amounted to a rather staggering total number of pages even though

* Revision of a paper presented at the Round Table on "Problems and Progress in State Statistics" at the 101st Annual Meeting of the American Statistical Association, Philadelphia, December 28, 1939.

it did not include the considerable number of current statistical publications that were issued from time to time within the various state departments relating to special studies, routine reports and other statistical documents not included in the regular annual reports. At the same time, the most casual observation indicated that there was a wide range of quality, at least as measured by the form in which tables were published. Some tables were inadequately described and were not accompanied by footnotes or textual description to indicate either the scope of their coverage or the accuracy of the basic data. In spite of this large volume of statistical material there could be found nowhere an adequate index of it, nor any publication which attempted to summarize the many basic facts. In other words, a great deal of valuable material had been produced but to a rather large extent it was lost to many people who would have found it useful had they realized that it existed. The public, of course, may have been at fault in not being sufficiently familiar with the activities of the public servants whom it paid to do this work to really know what they were doing. In any case, it indicated a lack of comprehensive planning and of scientific approach to the problem of getting this material out where it could be used readily by those who are seeking earnestly for the kind of facts that, were they readily available, would be used.

Since that study was made, state statistical services have increased by leaps and bounds, primarily through the growth of those agencies that are planned especially to alleviate human misery, including activities such as unemployment insurance and the work of welfare agencies.

Among the proposals that have been informally advanced in New York to clarify the situation with respect to coordination of statistics, there are several kinds. One promising type would appear to be provision for the publication of a year book of state statistics modeled in a general way after the *Statistical Abstract of the United States*, possibly with some amplification. Another suggested approach would be the formation of some central authority similar to the Central Statistical Board of the United States government. This Board could be useful in bringing about correlation of various state activities. At no time has the idea been seriously suggested that there be any agency resembling a central statistical bureau which would do all of the statistical work for the state. It is generally felt that effective statistical work requires not only a knowledge of routine and technical statistical procedures, but also close contact with the agency most concerned with the particular field. The preparation of an index of statistical work done by state agencies, if thoroughly done, also offers possibilities as a starting point for co-

ordination. The pioneering in Wisconsin and the awakening interest in Pennsylvania, Connecticut, and other states is encouraging.

There have been at least two committees on coordination of state statistics in the Albany Chapter of the American Statistical Association. The problems are so baffling that as yet no recommendations have reached the point where they warrant public presentation. Here is a most important field both from the standpoint of advancing the science of statistics and also from the standpoint of giving assurance that the public gets the most for every dollar of expenditure for statistical work.

In addition to the economy which would result from making statistical results more easily and generally available to the public, certain minor economies can be visualized, such as cooperation in the use of highly specialized facilities that an individual department can scarcely justify for its own exclusive use. For example, there come to mind, without detailed enumeration, eight individual departmental installations of punch card tabulating equipment in Albany, used for accounting or statistics or both, ranging in extent from the minimum equipment necessary to operate at all, to one of the notably large installations in New York State. Even at this, some departments are handicapped by lack of facilities. It is not suggested that the material to be processed on punch cards could all be handled centrally; nevertheless, it would appear that there could be a much higher degree of centralization than exists at present, which would have the advantage of making available more highly skilled supervision and operation to those departments which do not have full time need for some of the more expensive types of machines, and would thus enable the various departments to make greater use of basic statistics that have been collected at large expense.

A word might also be said about the internal coordination of statistical work within departments. It is quite evident that even within individual departments there is in some cases a situation which might be illustrated by the adage—"Let not thy right hand know what thy left hand doeth." This of course arises either from lack of appreciation on the part of administrative officials of the value of statistical work or lack of ability of statistical workers to bring about coordination.

In New York State and in many other states, the successive Legislatures have made available rather large amounts of funds that have found their way into the collecting, compiling, analysis, and publication of statistics over a broad field. It would seem that further attention should be given by the statisticians themselves toward making this money even more effective than it is at present in rendering public

service. It is possible that if the statisticians do not do this, administrative or legislative officials will eventually give the matter even closer scrutiny than at present and may plan for the necessary coordination in a way which would be much less effective than if it were to be done on the initiative of the statistical profession.

Turning now to personnel matters, a few words may be said about the development of professional standards in the state service. The first factor in good statistical work is of course the worker. Given competent workers and good leaders, supported by sound administration, rapid progress in statistical development is to be expected. In New York, statistical workers have generally been under State Civil Service for many years. However, when the Joint Legislative Committee began its study of Civil Service positions in New York which resulted in a Report on Classification of Positions in the Civil Service, presented to the Legislature in 1932, there appeared to be no well defined and generally accepted concept either of statistical jobs or of minimum qualifications for statistical workers. That committee, through its technical staff and in consultation with an advisory committee of statisticians and actuaries, laid the ground work for fairly definite classifications of the positions then existing, together with statements of minimum qualifications for the various positions.

Following that report there appears to have been a generally awakened interest in defining statistical positions and an increasing amount of discrimination in setting up qualifications and examinations for statistical workers. Nevertheless, when the Temporary Salary Standardization Board created in 1937, rendered its first report to the Legislature in 1938, it allocated the technical or professional statistical workers in the state service to a salary grouping that placed them in a class which was distinctly sub-professional in level as measured by salaries when compared with other similar positions, such as those in engineering, law, etc. This action was based by the Board not so much on a misconception of the real qualifications needed by statisticians as on the facts relating to training and salary level of those already in service. The Board found that some of the persons having the title "statistician" were in reality lacking in professional training and were doing work that should be classed as clerical in grade. Further, the Board did not appear to be aware that there is a professional organization of statisticians. The Board also concluded that statisticians were perhaps not entitled to be placed in a professional group since there did not appear to be any higher educational institutions, similar, for example, to engineering or law schools, which in the popular mind could be identified as schools or colleges of statistics.

Following the first report of the Board to the Legislature, an opportunity was granted for appeals from allocation of positions and several appeals were entered. The Temporary Salary Standardization Board gave an opportunity for statisticians to present their case and this was done in a detailed brief and in a hearing held in the spring of 1938, under the general leadership of the officers and members of the Albany Chapter of the American Statistical Association. At this hearing it was pointed out that the actual requirements as set up for Civil Service examinations in recent years had distinctly exceeded the minimums called for in the classification report in 1932, that a considerable number of statisticians were prepared by experience of a high order of professional achievement and by advanced training evidenced by earned degrees obtained as a result of graduate work. It was also brought out that there were a number of colleges and universities that gave relatively large amounts of instruction in statistics and that there is a professional association, namely, the American Statistical Association which had been in existence nearly a century. The statisticians were given an opportunity also to file with the Temporary Salary Standardization Board and the Department of Civil Service a report setting forth their ideas of minimum standards. The Temporary Salary Standardization Board in reporting to the 1939 Legislature gave statisticians a salary grading in line with the general professional level, starting with junior statisticians at $2100, which is $100 above the level for the corresponding federal grade, and with the higher grades rather closely in proportion or somewhat higher than the corresponding federal grades.

At the same time, representatives of the State Department of Civil Service encouraged the members of the Albany Chapter to collaborate with that Department in further development and refinement of standards and in determining the form and content of examinations to be held. The Department of Civil Service recently issued specifications for statistical positions, incorporating recommendations of a committee of the Chapter. The Committee on Professional Standards of the Chapter is still working on these problems and further progress is to be expected. It is believed that some changes will necessarily take place as continued experience calls attention to possible improvements.

As matters now stand, the entrance to the professional statistical ranks in the state service requires graduation from an approved college with rather comprehensive statistical training and, in addition, at least a year of high grade statistical experience or of graduate work having major statistical emphasis. Higher grades require further experience or education or both and demonstrated statistical ability. While there is a great deal still to be learned as to the qualifications necessary for mak-

ing a first rate statistician in the public service, marked progress has been made. The question can still be raised as to the actual relative importance of knowledge of the subject matter field in which the statistician will work as compared with advanced statistical training without respect to such knowledge of subject matter. There is also much to be learned about selecting workers from the standpoint of their capacity to do team work, to exercise initiative, to work energetically and produce an adequate volume of output. The ability of statisticians to think through the problems to such an extent that their statistical findings may be of the utmost public value to administrators and to the general public is something that needs to be canvassed much further.

Another challenging group of problems in the state service centers about the relationship that should exist between the statistical workers and the general administration of the various state agencies. This is a complicated subject. On the one hand, the statistician is likely to be somewhat hesitant about pressing his services with too much ardor upon the chief officials of his state agency. On the other hand, many administrative officials have never been schooled in the use of statistics as a tool; in fact, they may find that the statistics which the statistical workers in their departments are compiling do not always cover the immediate problems that they have to face. This function of statistical work as related to the general administrative field appears to be proceeding along healthy lines in New York State.

In closing it may fairly be said that statisticians in state service are faced with numerous problems both of administration and of public relations. Sensing these problems, it is to be expected that reasonable progress will be made in their solution. The public interest demands this.

DIABETES MORTALITY: A STATISTICAL ANALYSIS

By Constance Wynn Altshuler
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With the discovery of insulin in 1922, life became vastly more secure for the person suffering from diabetes mellitus. No longer did he have to starve in order to keep his blood sugar within normal limits; no longer was the slightest infection likely to lead to diabetic coma and death. More recently, new types of insulin have been developed and in the connection an immense amount of work on diabetes therapy has been done. Methods of diagnosis have improved greatly and specialists now say that there is no reason why any one should die of diabetes.

With all the advances in treatment, however, the death rate for this disease has risen enormously and continues to rise. The crude death rate[1] per 100,000 has been:

1927	16.8	1933	24.1
1928	17.6	1934	24.4
1929	18.3	1935	24.4
1930	18.4	1936	24.7
1931	21.1	1937	25.0
1932	23.0		

The rate of increase is even greater than it was before the discovery of insulin. From 1911 to 1922 the mean annual increase in the death rate was 0.16 per 100,000, or 1.0 per cent of the mean death rate for the period, while from 1924 to 1935 it was 0.40 per 100,000, or 2.1 per cent of the mean rate.[2] These rates are based upon the policyholders of the Metropolitan Life Insurance Company. Figures for the general population of the United States follow the same trend.

Here, then, is a paradox: As the treatment for diabetes melitus has improved, the death rate for this disease has risen.

To investigate in part the problems which this paradox raises, this study was undertaken to determine:

1. Of what do people with diabetes die?
2. How are these deaths reported in mortality statistics?

Permission was secured from eighteen hospitals in the Detroit area to examine the charts of all patients with diabetes mellitus who died in these hospitals during 1937. The cause of death which appears upon the hospital chart was recorded and compared with the principal cause of death which appears on the death certificate. Note was made of the

[1] *Statistical Bulletin* of the Metropolitan Life Insurance Company, Vol. 19, No. 1, January, 1938.
[2] Dublin and Lotka, *The Mortality from Diabetes*, Metropolitan Life Insurance Company, New York, 1938.

way in which each case was tabulated in the mortality statistics; this tabulation is hereinafter referred to as "vital statistics classification."

The vital statistics classification is decided arbitrarily. Of all of the causes of death—both principal and contributory—which appear on the death certificate, the one which takes precedence according to the *Manual of Joint Causes of Death* is considered to be *the* cause of death and the case is attributed to this cause in mortality statistics. For those certificates filed with the Detroit Board of Health, the vital statistics classification is noted by code number on the certificate. For those certificates filed in other municipalities, the investigator consulted the *Manual of Joint Causes of Death* to make this classification. The results of this investigation are presented in Table I.

TABLE I

DISTRIBUTION OF CAUSES OF DEATH ACCORDING TO HOSPITAL CHART, DEATH CERTIFICATE, AND VITAL STATISTICS CLASSIFICATION

Cause of Death (Int'l List Numbers)	Hospital Chart	Death Certificate	Vital Statistics Classification	Cases in which all three agree
Typhoid (1)	1			
Tuberculosis (23–32)	5	5	6	4
Lues (34)	1			
Septicemia (36)	1	3		
Carcinoma (45–53)	12	12	12	12
Diabetes (59)	80	82	142	59
Diseases of thyroid (66)	1	1	1	1
Leukemias (72)	1	1	1	1
Cerebral accidents (82)	16	17	5	3
Circulatory system diseases (90–103)	30	38	6	5
Pneumonia (107–109)	29	19	5	4
Embolism (111)	1	4		
Appendicitis (121)	3	1	2	1
Hernias & obstructions (122)	2	2	1	
Hepatic diseases (124–125)	2	1	1	
Biliary tract diseases (126–127)	1	2	1	
Diseases of pancreas (128)	2			
Peritonitis (129)		1		
Nephritis (130–132)	6	5	2	
Diseases of kidneys (133)		1		
Diseases of urethra (136)	1	1		
Diseases of prostate (137)		1	2	
Carbuncle (151)	1	2	1	1
Abscess (152)	2		1	
Senility (162)		1		
Violent and accidental deaths (163–210)	6	4	13	2
Total	204	204	204	93

Of the entire group of 204 patients, 142, or 69.6 per cent, were recorded in the vital statistics classification as having died of diabetes mellitus, while in the opinion of attending physicians as indicated on the hospital charts and the death certificates only about 80 patients died of this disease. (The 80 include deaths from coma, acidosis, gangrene, and post-operative deaths after amputation.) In only 59 cases did the hospital chart, the death certificate, and the vital statistics classification all agree upon the diagnosis of diabetes.

Another, but less pointed, discrepancy lies in these groups:

Cause of death	Hospital chart	Death certificate	Vital Statistics Classification
Circulatory system diseases	30	38	6
Pneumonia	29	19	5

The first two sets of figures become more harmonious when it is noted that in five of these cases terminal pneumonia was reported on the hospital chart as the primary cause of death, whereas the basic cardiac complaint for which the patient was hospitalized appeared upon the death certificate. Comparing the last column with the first two, however, it is seen that from 57 to 59 deaths were attributed to cardiac conditions or pneumonias or a combination of these causes by the hospital charts or death certificates, while only 11, or about 19 per cent, were placed into these two groups in the vital statistics classification. In these 11 cases diabetes was not mentioned on the death certificate or the classification would have been changed.

In studying these figures it becomes of interest to know to what extent the three sources of information agree upon the principal cause of death. This is shown in Table II.

TABLE II

EXTENT OF AGREEMENT UPON THE CAUSES OF DEATH

Agreement	Cases	Per cent
Agreement of all three sources	93	45.5
Agreement of H and D only	40	19.6
Agreement of H and V only	27	13.3
Agreement of D and V only	24	11.8
No agreement	20	9.8
	204	100.0

H designates hospital chart
D designates death certificate
V designates vital statistics classification

In 93 cases, or 45.5 per cent, all three sources agreed upon the cause of death, and in an additional 24 cases, or 11.8 per cent, the vital statistics classification and the death certificate agreed. This means that 57.3 per cent of the cases were classified in mortality statistics under the

same cause as that which was listed upon the death certificate as the principal one. Then, 42.7 per cent of the cases were placed into some category other than that which the attending physician considered to be the essential cause of death.

In the group of 20 cases in which there was no agreement among the hospital chart, the death certificate, and the vital statistics classification, the difference is more apparent than real. In ten of these cases the hospital chart gave a terminal pneumonia or uremia as the cause of death, while the basic complaint—nearly all of these are cardiac cases—appeared upon the death certificate. The difference, then, is between the vital statistics classification and the other two sources.

On 32 death certificates, or 15.7 per cent of the group, diabetes was not listed among the causes of death. In 14 of these cases the omission would have made no difference in the vital statistics classification, but in 18 cases the mention of diabetes on the death certificate as a contributory cause would have resulted in classification of the case as a death due to diabetes.

According to the *Annual Report* of the Michigan Department of Health, 371 deaths were listed as due to diabetes mellitus during 1937 in the area of this survey. Of these 142, or 38.3 per cent, are included in the group studied.

Of the 204 diabetic patients whose death records were examined, 19, or 9.3 per cent, were Negroes. This coincides reasonably well with the 1930 census report, according to which 7.7 per cent of Detroit's population were Negroes. Since many observers have pointed out that women are more subject to diabetes than men, it was anticipated that this group would include more females than males. This was actually the case: 122, or 60 per cent, of the patients were females. Of the total number of deaths from diabetes listed in the state report[3] 64.1 per cent were females.

In the group studied 89.9 per cent were 45 years of age or over. For the entire state, 90.9 per cent of the deaths due to diabetes occurred among persons 45 years of age or over. The tabulation by birthplace is as follows:

Native born	105, or 51.5 per cent
Foreign born	97, or 47.5 per cent
Unknown	2, or 1.0 per cent

The percentage of foreign born is very much higher than it is in the general population, but this may be accounted for by the preponderance of middle-aged and elderly people among these cases.

[3] *Annual Report* of the Bureau of Records and Statistics for the Calendar Year 1937, Michigan Department of Health.

Since the group of 204 cases in the sample includes more than one-third of the entire number of persons who were reported to have died of diabetes in the area of the survey during the year, and since the characteristics of the group correspond with what might be expected, this sample is an adequate one from which to draw conclusions.

It has been shown that of the 142 cases listed as deaths due to diabetes mellitus in the vital statistics classification only 80 to 82 or 56.6 per cent, were indicated to have died of that disease according to the opinion of attending physicians as shown on the hospital charts and the death certificates. It has also been shown that the vital statistics classification agrees with the principal cause of death on the death certificate in 56.8 per cent of the cases. It would take a great deal more study to determine whether the coincidence of these figures is significant. From these observations it appears that statistics on deaths due to diabetes mellitus, when determined on the basis of the *Manual of Joint Causes of Death*, differ by about 40 per cent from those based upon the opinions of the attending physicians.

According to the *Manual of Joint Causes of Death*, diabetes mellitus takes precedence over nearly one hundred other complaints, including pneumonias and all cardiac conditions. These are extremely important inclusions, since cardiac diseases and pneumonias are the two leading causes of death. It has been estimated by the Bureau of the Census[4] that 1 death in every 6 is due to cardiac diseases, and that 1 in every 8 is due to influenza and pneumonia. With 90 per cent of the group studied 45 years of age and over, it is to be expected that a great many of them would have diseases of the circulatory system. Possibly the rise in the diabetes death rate might be largely accounted for by the survival of diabetic persons up to the ages where they begin to be subject to cardiac complaints and other degenerative diseases of middle- and old-age. This is borne out by Dublin and Lotka's observation[5] that the death rate from diabetes is falling among persons under 45 years of age and rising enormously for persons over that age.

The practice of giving equal weight to all complaints which appear on the death certificate, regardless of whether they are designated as principal or contributory causes, may lead to a considerable error in the computation of vital statistics. Although the physician is asked to differentiate between the principal and contributory causes of death, no account is taken of his opinion in this matter. Thus, the causes of death which take precedence appear to become very heavily weighted, as is

[4] *Physicians' Pocket Reference to the International List of Causes of Death.* (Eighth Edition.) Bureau of the Census, 1931.

[5] Dublin and Lotka, *The Mortality from Diabetes*, Metropolitan Life Insurance Company, New York, 1938.

seen in Table III. According to this table more deaths due to diabetes and to violent and accidental causes are reported in the vital statistics classification than actually took place in the opinion of the physicians; but no person with diabetes is tabulated as having died of pneumonia or of a cardiac condition unless his physician has neglected to mention the diabetes on the death certificate.

Whether the observations made on this group apply to the rest of the diabetic population would be difficult to say. It would have to be determined whether there are any differences in the cases of persons dying in hospitals and those dying elsewhere. Certainly some conditions and complications—anything which involves an operative procedure, for example—would be found only in hospitals but whether there is any difference in the rate of deaths due to diabetes, to circulatory system diseases, or to pneumonias, it would take a good deal of further investigation to decide.

TABLE III

CAUSES OF DEATH AMONG DIABETIC PATIENTS

Cause of Death	Hospital Chart and Death Certificate, per cent	Vital Statistics Classification, per cent
Diabetes	39.5	65.3
Circulatory system diseases	15.6	2.9
Pneumonias	11.9	2.4
Cerebral accidents	7.9	2.4
Carcinoma	5.9	5.9
Nephritis	2.5	1.0
Tuberculosis	2.4	2.9
Violent and accidental deaths	2.4	6.5
Other causes	12.0	10.7
	100.0	100.0

Two-thirds of the patients with diabetes die of diabetes, circulatory system diseases, or pneumonia. Within this group the distribution is:

Diabetes	40 per cent
Cardiacs and pneumonias	27 per cent

In the vital statistics classification 70 per cent of the deaths fall into these three divisions, but they are distributed thus:

Diabetes	65 per cent
Cardiacs and pneumonias	5 per cent

It is concluded that the present system of classifying deaths involving diabetes mellitus does not agree with the opinions of the attending physicians, and that therefore rates based upon this classification are open to question.

ON THE BARTELS TECHNIQUE FOR TIME-SERIES ANALYSIS, AND ITS RELATION TO THE ANALYSIS OF VARIANCE

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I. INTRODUCTION

It has long been recognized that there is difficulty in applying the usual statistical techniques when there is correlation between successive items in any given sample. This trouble arises in many different fields: in economic time series the index number for any one day, month, or year is dependent on that of the preceding time unit. In sociology the number of strikes in progress at any one time is dependent on the number at some immediately preceding time. In agricultural experiments the yield of any plot will be high or low with the fertility of the adjacent region. This characteristic is known by various names, among statisticians as serial correlation, among physicists as *nachwirkung* or persistence. Various devices are used by statisticians to circumvent it, but the problem is by no means solved. For this reason it may not be amiss to bring to the attention of statisticians an approximate intuitive device used on similar problems by physicists, with the hope not only that the method in its present form might prove of some value to statisticians, but also that they may be stimulated into a more critical study of the technique.

II. CORRELATION OF TIME SERIES

Simple examples showing the difficulties introduced by the application of formulas derived for random samples to data involving persistance are the correlations between time series. In a well-known paper Yule[1] gives as an example a correlation between Church of England marriages and standard mortality, for which a coefficient of $+0.9512$ with the very small standard error of 0.0140 was obtained. He points out that in spite of its "high significance" ($P \ll 0.01$) such a result in this case is obviously nonsense, and shows that in the series in question there exists a high degree of positive serial correlation, that is, successive observations are not independent but are related in such a way that high values are likely to be followed by other high values. He does not however suggest any way to obtain a valid measure of the significance of a correlation coefficient between series of this kind, con-

[1] U. Yule, *Journal Royal Statistical Society*, vol. 89, pp. 1–69, 1926.

cluding only that, in a series "in which successive terms are closely related to one another, the usual conceptions to which we are accustomed fail totally and entirely to apply."

The above example was deliberately chosen to develop a case of *reductio ad absurdum*, but in a serious work, *The Social Aspects of the Business Cycle*, we find a similar example. For the correlation coefficient between prosperity and mortality Thomas[2] is surprised to find the positive value +0.31 with a standard error of only 0.12 making the result "significant" ($P=0.01$) according to the usual rules. Such cases have led to the absurd situation in which the statistical tests for significance are often ignored and, as quoted by Mitchell,[3] " . . . an expert . . . (does) not consider of much value a correlation coefficient below 0.90."

To statisticians of the sociological-economic school the above situation apparently remains as an unexplained anomaly, for as recently as 1935 in discussing the correlation by Thomas above, Bartlett[4] suggests only that the result obtained must be due mainly to a particular coincidence with the influenza epidemic, and concludes that "If neither series is random no valid test . . . (for the statistical significance of correlations) . . . can be recommended."

Seeking a more general explanation of the above anomalous situation we recall that the formula for the correlation coefficient is derived on the assumption of independence of successive observations. To test our data for independence we may choose to use the fundamental proposition that if a variate is distributed with standard deviation $\sigma(1)$, then the mean of a random sample of h such variates is distributed with standard deviation $\sigma(h)=\sigma(1)/\sqrt{h}$. That is, for independent observations the ratio

$$d_h = h\sigma^2(h)/\sigma^2(1) \tag{1}$$

should be statistically constant and equal to unity if enough observations are used.

Taking successively $h=3$, 5, 9 for the marriage series in Yule's data we get the curve d_h in fig. 1. Obviously the requirement that $d_h=$ unity is not satisfied, so the data are not independent. Similarly for Thomas' data we get for $h=5$, 10, 15 the curve d_h in fig. 2. Again it is clear that the data are not independent, and the usual formula for the correlation coefficient should not be used.

Thus, we are confronted with the problem of estimating in some way

[2] D. H. Thomas, *The Social Aspects of the Business Cycle* (C. P. Dutton, 1925).
[3] W. C. Mitchell, *Business Cycles* (National Bureau of Economic Research, 1927), p. 270.
[4] M. S. Bartlett, *Journal Royal Statistical Society*, vol. 98, pp. 536–543, 1935.

the number of independent components among any number of dependent ordinates.

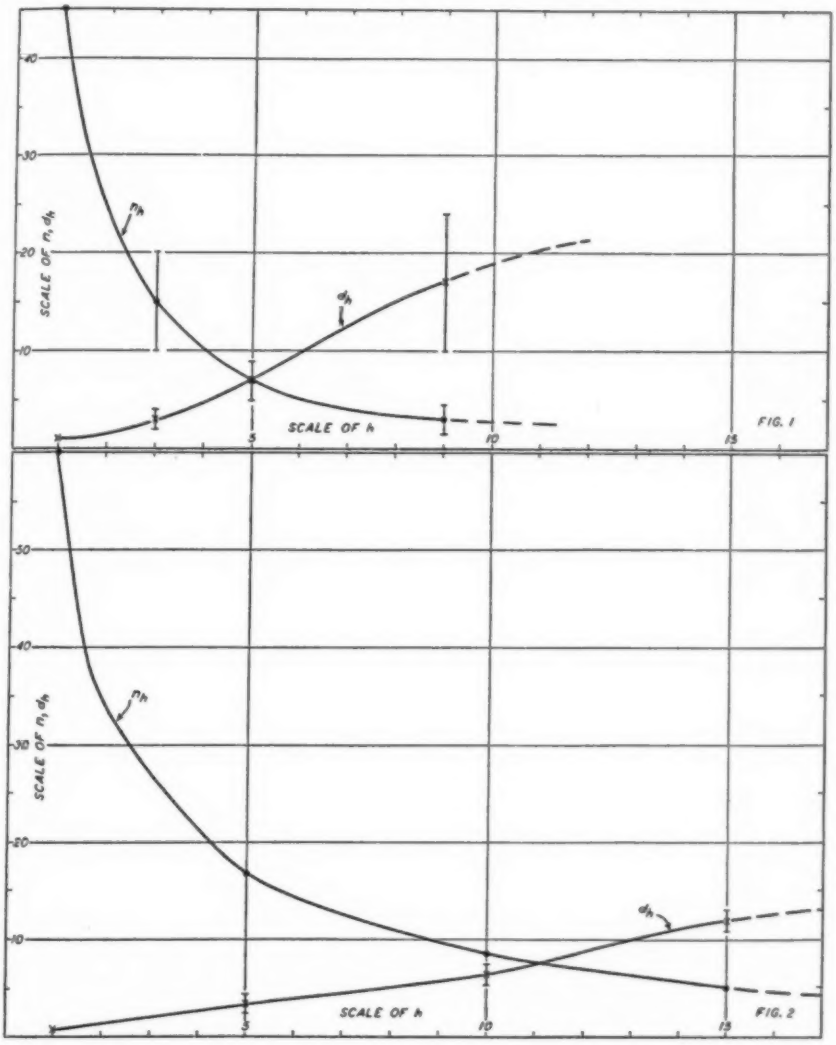

Fig. 1 (Upper panel).—Number of effectively independent observations in Yule's example.
Fig. 2 (Lower panel).—Number of effectively independent observations in Thomas' data.

III. THE BARTELS TECHNIQUE

A rigorous solution to the problem is difficult, but an approximation is available and is much used by physicists, who are convinced that "it is useless to labor over the farthings when the pounds are uncer-

tain." The technique referred to was developed by Bartels[5] in the study of quasi-persistent periodicities, and can be explained as follows.

TABLE 1
ORDINATES OF A TIME SERIES

Year	Nine-Year Groups of Years						
	I	II	III	IV	V	VI	VII
0	133	133	116	125	94	99	102
1	94	136	101	109	92	99	119
2	79	155	97	131	85	110	94
3	83	95	102	126	77	132	101
4	61	59	104	110	83	100	100
5	77	61	98	81	108	80	101
6	93	83	107	92	87	58	107
7	97	106	88	90	84	38	108
8	120	121	128	93	88	49	104

Consider a set of observations like those in table 1. We may test these data for independence, as above, by means of the formula for d_h in eq. (1). The result is the curve in fig. 3. Again the requirement

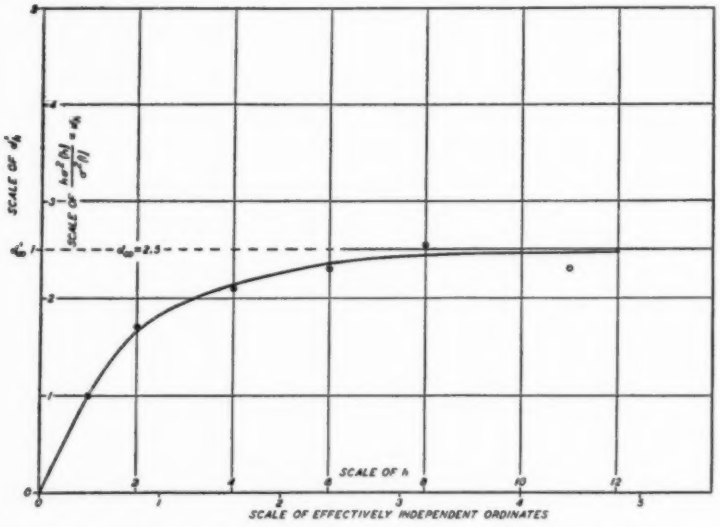

Fig. 3.—Number of effectively independent observations in Greenstein's data.

that $d_h = 1$ is not satisfied and the data are not independent. However, a peculiar feature of the curve may be noted. Above about $h = 5$ the value of the ratio is nearly constant and equal to (say) $d_\infty = 2.5$ in the

[5] J. Bartels, (a) Thesis (Göttingen, 1922); (b) *Zur Morphologie Geophysikalischer Zeitfunktionen*, Sitzungsberichte. Preuss. Akad. Wissensch., Phys.-Math. Klasse, pp. 504–522, 1935; (c) *Terrestrial Magnetism*, vol. 40, pp. 1–60, 1935; (d) "Verbogene periodische Erscheinungen" in Lubberger's *Wahrscheinlichkeiten und Schwankungen* (J. Springer, Berlin, 1937), pp. 66–73.

present case, so that for values H of h sufficiently large, the quantity $(H/d_\infty)\sigma^2(H)/\sigma^2(1)$ is unity. Comparing this with eq. (1) we see that $\sigma(H)$ is related to $\sigma(1)$ *as if* the averages of H successive ordinates were derived from H/d_∞ independent components. For this reason we call H/d_∞ the number of "effectively independent components among H successive ordinates." This process in effect calibrates our hitherto unknown scale of effectively independent components by means of the "calibration point" d_∞.

Bartels[5d] illustrates the meaning of the parameter d_h as follows. Consider a series of values $S_1 = a_1, a_2, a_3, a_4, \cdots$ taken at random from an infinite supply of values with standard deviation $\sigma(1)$. Divide this series into sets of h successive values and form averages for each set; the standard deviation for these averages should be statistically $\sigma(h) = \sigma(1)/\sqrt{h}$ if the original members of the sequence S_1 are independent. Now form a new series S_d from S_1 by repeating each value d times; for instance, with $d=4$, S_4 would be $a_1, a_1, a_1, a_1, a_2, a_2, a_2, a_2, \cdots$. The series S_d will still have the standard deviation $\sigma(1)$, but if it is divided into successive groups of $h = dh'$ (h' any integer)[6] the standard deviation for the average of these groups will be

$$\sigma_d(h) = \sigma(1)\sqrt{h'} = \sigma(1)\sqrt{(d/h)}. \tag{2}$$

Conversely, if only $\sigma_d(h)$ and $\sigma_d(1)$ were known for the series S_d, the number d of identical ordinates could be found by means of the formula

$$d = h\sigma^2(h)/\sigma^2(1). \tag{3}$$

For actual time series no rigorous treatment is possible, but so far as they may be considered analogous to the series S_d, differing only in the degree of correlation between successive items, the same considerations apply. This analogy is the justification for the use of the terms chosen to describe d_h and h/d_h in the general case.

The probable error in any estimate of the d_h of eq. (1) may be approximately determined as follows. The standard deviation in any estimate of $\sigma(1)$ made from m independent observations will be $\sigma(1)/\sqrt{(2m)}$, while that in the estimate $\sigma(h)$ will be $\sigma(h)/\sqrt{(2m/h)}$.

[6] For the case when h' is not an integer, $d=4$ and $h=3$, for instance, the groups would cut up the sequences of identical ordinates and the equation for d_h would not hold. This defect, which could be examined in detail, does not detract, however, from the illustrative value of the analogy, especially because its effect vanishes if h is large compared with d, which should be true in any case for this technique to be strictly applicable. Of course the value of d_h may depend on the way in which the groups of h intervals are divided; for instance, whether we begin with the values 1 to h, or 2 to $h+1$, etc. Such cases occur in geophysics and the possibility must always be kept in mind. This effect in itself may sometimes deserve special attention but in order to avoid secondary complexities, let us consider $\sigma(h)$ to be derived from all averages, obtained from all possible combinations, of h successive ordinates.

Now for a quotient x/y, we know that when x and y are independent, the standard errors are related by the equation

$$[\sigma_{x/y}/(\bar{x}/\bar{y})]^2 \doteq (\sigma_x/\bar{x})^2 + (\sigma_y/\bar{y})^2 \tag{4}$$

as can be found in any treatment of the propagation of error. So here' the mean percentage error in d_h will be $\sqrt{[a^2+b^2]}$, where a and b are the mean percentage errors in the numerator and denominator. For large values of h the mean error in an estimate of $\sigma(1)$ will be negligible in comparison with the mean error in the estimate of $\sigma(h)$, wherefore the mean percentage error in d_h will be practically that in $\sigma^2(h)$. For small values of h the mean percentage errors in the estimates of $\sigma^2(h)$ and $\sigma^2(1)$ may be nearly equal, in which event the above argument does not apply. In this circumstance we may set an upper limit to the error in d_h by assuming the errors in the estimates of $\sigma^2(h)$ and $\sigma^2(1)$ to be always operating in the same direction, giving $\sqrt{[a^2+b^2]}=\sqrt{[a^2+a^2]}=2a$, or twice the error in either one alone.

The error in d_∞ of course depends on the method of extrapolation. Its error must therefore be judged from the behavior of curves such as that given in fig. 1 where a constant value of d_∞ will be attained only if the effect producing the persistence is constant. However, these approximations are adequate for the case in hand, for the quantity $h\sigma^2(h)/\sigma^2(1)$ is itself used as a correction and its error must be a second order effect.

IV. APPLICATION

Adopting Bartels' concept of "effectively independent components" we may now reconsider the examples discussed in section II. In Yule's data the total number N of items may be divided into groups of h items each. Within each of these groups there are h/d_∞ "effectively independent components" (section III) giving

$$n_h = (N/h)(h/d_\infty) = N/d_\infty \tag{5}$$

as an estimate of the total number of independent components on which the correlation coefficient might be based.[7] From fig. 1, though no accurate estimate of d_∞ may be made due to the large error in extrapolating d_h, we may safely conclude that $d_\infty > 15$ and that $n \ngtr 3$, so that instead of being based on the 45 recorded items, the correlation coefficient was actually based on only three independent components, whence applying the usual t test we find the significance level at $P=0.2$, wherefore the correlation coefficient no longer need be considered significant.

[7] Of course more rigid tests would consider both series, which may have different degrees of persistence. It would be interesting to consider whether the number of effectively independent *pairs* of values might be obtained from the equivalent numbers of independent components in the two series.

Similarly, for Thomas' example, we find from fig. 2 for the mortality series that there are less than five independent pairs of observations so that the "significance" does not even reach the level of $P=0.6$, and we are no longer obliged to find excuses for the result.

Thus, bearing in mind only the fact that the standard error of a correlation coefficient is determined by the number of *effectively independent* observations, we see that Bartels' technique provides us with a safeguard such that the correlation coefficient becomes harmless, even in inexperienced hands. Furthermore we find that, contrary to the conclusions of Yule, the ordinary concepts of statistics do apply and the usual tests for significance remain valid.

V. THE RELATION BETWEEN BARTELS' TECHNIQUE AND THE ANALYSIS OF VARIANCE

In the above examples Bartels' technique was applied to series of numbers that are related in time. Since the mathematical operations apply only to the numbers, being quite independent of what the numbers represent, the same technique may be applied to series of numbers related in space or in any other natural way.

A typical example is given by the so-called station-year rainfall record.[8] In this case we have, let us say, 30 years of observations at each of 40 neighboring stations. Such a record has been regarded as equivalent to 1200 years of observations at a single station under the same general climatic conditions. Accordingly, in the desire to know the frequency of occurrence of storms above some specified amount of rainfall, and particularly to obtain an estimate of the reliability of this frequency, it has been customary to assume that a storm magnitude which has been reported (say) 12 times in the entire series of observations would have a frequency of occurrence of once in 100 years, with the implication that this value is fairly reliable, being based on 12 observations.

A procedure of this kind is hardly valid, for it is probable that these 12 observations were recorded during only 3 or 4 separate storms, and quite possible that all were recorded at the 12 different stations during a single storm. In fact, by applying the chi-test to such data we shall usually find that the means for the stations are much more alike than would be expected for random data. This, however, tells us only what we already suspect; namely, that a single storm may be hitting several stations simultaneously. Similarly, from the analysis of variance, we

[8] Miami Conservancy District, Engineering Staff, *Storm Rainfall of Eastern United States* (Dayton, revised ed., 1936). See however, K. C. Clarke, *Transactions American Geophysical Union*, 1938. See also H. Wold, *Stationary Time Series* (Upsalla, 1938).

should conclude only that there are unexpectedly large differences between the means of the years, with correspondingly small difference between the means for the stations.

We desire, therefore, to segregate in some way the independent events, or at least to find out how many there are. We are thus again faced with the problem of estimating the number of independent components among an arbitrary number of related observations. Resorting to the Bartels' technique, we may adapt it to an $r \times s$ table of a station-year record of storms by setting the rows, or years, end to end successively and grouping the resulting series in the manner described earlier, using $h = 2, 3, 4$, etc., until the ratio d_h seems to have reached a constant value. The number d thus arrived at will be an estimate of the number of stations hit by a single storm. As a matter of fact, the number d thus estimated will usually be too small, and we shall ordinarily be safe in saying that the actual number of stations affected is still larger, for if a single storm hits several stations, geographically adjacent, these stations will in general not all be entered in adjacent columns in the table, thus effectively reducing the amount of persistence, and its index, the number d. Similarly for storms at the edge of the area, the boundary effect will tend to reduce the number of stations affected by a single storm. Thus for a station-year record of storms we may safely conclude that the actual average number of stations hit by a single storm is larger than d, and the effective length of record even shorter than that given by a simple application of the Bartels method.

In the above example the correlation existed between adjacent items in the rows, but examples are easily found in which the persistence is mainly in the columns. Thus Fisher[9] shows a table of the frequencies of rain at different hours in different months, with successive hours in vertical columns. Clearly the fact that it is raining at any given time is not independent of whether it was raining one hour earlier, and persistence is to be expected. Applying the usual formula for d_h it is found that $d_{24} = 13.1$, so that only about two of each days' observations are effectively independent. Cases can also be found in which persistence has been introduced into both rows and columns. For these, special methods will have to be developed.

Thus we find ourselves in a situation which may be likened to the following game. Starting with a set of random numbers such as may be taken from Tippett,[10] we may allow an assistant (or nature) to perform secretly certain operations on these numbers. The problem for the statistician is to test the resulting numbers in various ways and to de-

[9] R. A. Fisher, *Statistical Methods for Research Workers* (Blackie & Son), table 44.
[10] L. H. C. Tippett, *Tracts for Computers* No. 15 (Cambridge, 1927).

duce from his tests what operations have been performed. The analysis of variance is a first test, for it may help to tell us whether the numbers are still random. Bartels' point of view enables us to go one step further and specify in certain cases the groupings used in the unknown operations.

There are many interrelations between the Bartels' parameters and other statistical conceptions, for example, the Lexis theory of supernormal and subnormal dispersion; hence one might expect that his parameters may also be expressed in the language of the analysis of variance. This is easily demonstrated by considering the mathematical formulation of the analysis of variance as given for example by Irwin.[11] It will be found that Bartels' parameters d_{rows} and $d_{\text{cols.}}$ are essentially the ratios of the "column mean square" to the "total mean square," and the "row mean square" to the "total mean square," respectively.

Thus Bartels' parameters may be obtained from the usual analysis of variance tables, provided only that the "total mean square," usually omitted, is also computed, and it should be possible to devise tests of significance based on analysis of variance methods which can be carried to any desired degree of refinement.

VI. HARMONIC ANALYSIS

Among economists the use of harmonic analysis is viewed with a healthy skepticism, largely because by its use apparent "real" periods are too readily found. Col. M. C. Rorty,[12] for example states:

> . . . The fudamental defect in the harmonic analysis is that it will resolve any ordinary business time series into definite regular periodicities, regardless of whether any real periodicities exist or not. . . . Probably the best indirect proof of the lack of value of the harmonic analysis is to create an artificial time series by throwing dice and then to analyze this series with and without assumptions as to lag.

Among physicists, on the other hand, harmonic analysis continues to be regarded as one of the most powerful and dependable tools for the study of time series of any kind. This curious diversity of opinion seems to be founded in the fact that Rorty is speaking of the harmonic analysis of Schuster,[13] whereas physicists are now using a modern form developed mainly by Bartels. This technique has been devised for the express purpose of investigating hidden periodicities in geophysical time series, which are usually encumbered with random fluctuations,

[11] J. O. Irwin, *Proceedings Royal Statistical Society*, vol. 94, pp. 284–300, 1931.
[12] W. C. Mitchell, *Business Cycles* (National Bureau of Economic Research, 1927), p. 261.
[13] A. Schuster, *Terrestrial Magnetism*, vol. 3, pp. 13–41, 1898.

cycles of changing phase or period, and persistence (serial correlation) between successive items, like the refractory time series encountered in sociological and economic investigations. Since the publication of Bartels' paper of 1935 his technique has been the standard procedure among physicists, yet the writer has been informed by "professional statisticians" that the Bartels' methods, being based on harmonic analysis, are "old-fashioned," and "not accepted by statisticians," and (by implication) that were physicists "properly trained" they would solve their problems by the use of the analysis of variance.

That a barrier between the two groups exists is clear from even a casual inspection of the literature on time series presented by exponents of the respective schools. Both schools accept as fundamental the work of the physicist Schuster, which was in turn based on the work of the physicist Rayleigh. After this time, however, further work by the investigators of the physical school seems to be largely ignored by the statistical school and we find two separate lists of standard references covering the same subject, with little duplication of authors. The statistician apparently reads papers by Moore, Crum, Mitchell, R. A. Fisher, Roos, Snedecor, etc., and adopts Slutzky[14] as a classic reference. The physicist reads papers by von Laue, Einstein, Taylor, Stumpff, and Pollack, and adopts the paper of 1935 by Bartels as his reference text. The statistician's development is based on the mathematical treatments of probability distributions, serial correlations, etc. The physicist's approach is by analogy with problems already solved in connection with the kinetic theory of gases, diffusion problems, Brownian motion, turbulence theory, and physical optics. Perhaps it is the frequent assumption of familiarity with the analogy which tends to make the work of the physical school relatively inaccessible to the pure statisticians. Conversely the use of such terms as "graduality" and "fluency"[15] as introduced by Slutzky for instance, make the statistician's work difficult reading for the physicist.

There is another factor that probably contributes to the segregation of the two schools. It seems that writers on sociological and economic time series have convinced themselves that the methods used in physics are valid only for pure sine wave phenomena, whereas these are seldom encountered in economic series.

[14] E. Slutsky, *Econometrica*, vol. 5, pp. 105–146, 1937.

[15] "The unconnected random waves are usually called irregular zigzags. A correlation between the items of a series deprives the waves of this characteristic and introduces into their rising and falling movements an element of graduality . . . ."

"We must distinguish between the *graduality* of the transitions and their fluency. We could speak of the absence of the latter property if a state of things existed where there would be an equal probability for either a rise or fall after a rise as well as after a fall . . . (Slutsky[14].")

To the economist, apparently quite certain of the meaning of "reality," Rorty's statement[12] quoted above, for example, constitutes damning evidence; to the physicist, grown accustomed to seeing even "solid rock" represented by ψ-waves and matrix elements, it is no evidence at all. The harmonic analysis gives a mathematical model of a time series just as the Schrödinger equation gives a mathematical model of an atom. The time series behaves *as if* it were composed of harmonics just as the atom behaves *as if* it were composed of ψ-waves, and the economist has quite as much right to deal with harmonic components that may never be isolated as a physicist has to deal with an equally intangible ψ-wave or matrix element.

The point is—to put it bluntly—if a period of any conceivable shape exists, then the harmonics that it may be composed of will also exist, and a test for the "reality" of the harmonics is automatically a test for the reality of the original period. That a wave of special shape should be indistinguishable from the sum of its harmonics is a totally irrelevant question.[16] Bartels' analysis of the 27-day recurrence phenomenon[5c] in magnetic activity gives a beautiful example of a case in which no simple physical meaning can be attached to the harmonic components.

Statements such as that by Rorty are made probably not so much in protest against the *use* of harmonic analysis as against the *conclusions* which are often obtained by its use. In this he is ably and effectively seconded by Bartels, in whose hands periodogram analysis has been freed from many of the objections that previously were entirely valid. For example, regarding Schuster's methods, Slutzky[14] in 1937, states:

> . . . we must give up his criterion when we remember that among his assumptions is that of independence of successive observations.

This is true of Schuster's early work, but the technique of Bartels was developed in order to avoid just this assumption.

In Schuster's method, $C(f_1)$ is the amplitude of a sine wave of a certain frequency f_1 obtained by a harmonic analysis of the total observed time series. For obtaining an estimate of E, which Schuster called "expectancy," he used his "periodogram" and assumed E equal to an average for all frequencies f (supposed to be free of actual periods) of the amplitudes $C(f)$. Schuster based this choice of E on the assumption that E is independent of the frequency. This equipartition of the variance is true for random series in which successive values are

[16] Such an ambiguity in interpretations is a commonplace occurrence in modern physics. See, for example, the discussion of the coupled pendulum given by C. G. Darwin, *The New Conceptions of Matter* (Macmillan, 1931), p. 170.

independent, but untrue for actual time series in which successive values tend to be alike (persistence tendency), as has often been pointed out by Bartels. To avoid this difficulty, which may lead to underestimating E many fold, Bartels devised an estimate of E on the basis of harmonic analyses for the same frequency f_1 as that to be tested, in suitable subdivisions of the entire series; thus the persistence tendency affects E in much the same way as C, tending to cancel its effect in the ratio. It will be instructive to consider an actual example in order to demonstrate his method.

In table 1 a series of numbers was given, representative of an economic time series. To illustrate Bartels' approach, suppose that these represent yearly values and that we wish to test for the reality of the nine year period frequently reported in the literature of economics.

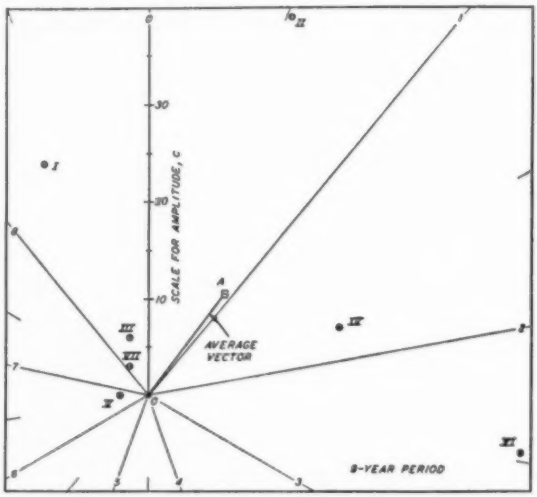

Fig. 4.—Harmonic dial for the data of Table I.

The values are arranged in seven groups of nine years each; the groups are numbered I to VII, the years in each interval from 0 to 8. Each group is harmonically analyzed to yield a sine wave,

$$c \sin (t + a)$$

with time t reckoned from the middle of year 0 of group I, and increasing by 2π in nine years. The results are plotted in the "harmonic dial" of fig. 4 which replaces the usual phase diagram. The nine year sine wave for each group is represented by the points numbered I to VII, or by the vector connecting the origin 0 with these points. This vector indicates by its length the amplitude c, and by its direction the

phase a which is taken as zero for the direction from zero toward the right, increasing counter-clockwise. The scale for the amplitude c is indicated; the time when each sine wave reaches its maximum can be read from the scale around the edge of the dial where the figures 0 to 8 indicate the midpoints of each nine year group. The average sine wave of a nine year period, obtained by a harmonic analysis of the total $7\times9=63$ years is indicated by the "average vector" OA. Now A is the mass center of the "point cloud" formed by the seven dots for the individual years, and this property of A may be used to test whether OA can be regarded as real, or whether it can be explained by a chance occurrence. The average vector OA has an amplitude of 13.1 units, and the root-mean-square amplitude of the seven individual waves is 25.2 units. Under random conditions the expectancy for the average amplitude of the seven individual waves is $25.2/\sqrt{7}=9.5$ units. Among several possibilities for the test under consideration Bartels chooses two:

(a) We suppose that the seven dots are chosen at random from a point cloud of a normal distribution, with root-mean-square amplitude 25.2 units and centered at O. What is the probability that the average vector OA ($=13.1$ units) exceeds its expectancy ($=9.5$ units) in the ratio $k=13.1/9.5=1.38$? The answer to this question, familiar in Brownian motion and random walk problems, is[17]

$$P_a = e^{-k^2} = 1/7. \tag{6}$$

(b) We suppose that the seven dots are chosen from a point cloud centered at A with root-mean-square distance from A to be calculated in the usual way as $\sqrt{(25.2^2-13.1^2)}=21.6$. The expectancy for the distance of the mass center of the seven dots from A is then $21.6/\sqrt{7}$ or 8.2. The probability that this mass center is more than $OA=13.1$ units distant from A is with $k=13.1/8.2$,

$$P_b = e^{-k^2} = 1/13. \tag{7}$$

Thus both of these formulations lead to probabilities for chance occurrence of the order $P=1/10$, which is hardly sufficient to warrant the contrary assumption of reality. As pointed out by Bartels, even these estimates of P may be too favorable to the assumption of reality because the data may be affected by "quasi-persistence."

[17] This calculation is made under the assumption that 25.2 is the root-mean-square amplitude for a long series of random points, of which these seven may be a random sample. Actually the standard deviations of samples of seven random points are not constant, but fluctuate from one sample to another, and the calculation made here does not take these fluctuations into account. While this might be done the result of such a calculation could hardly be called a refinement because it would remain subject to fluctuations. What is more, the phenomenon of "quasi-persistence" may be, and probably is, present, so it seems satisfactory merely to regard P_a itself as subject to fluctuations.

Thus our task would be finished, except for the fact that applying the tests of significance available in the literature at the time he made his study, Greenstein[18] finds from the *very same data*, which give the number of business failures per 10,000 business concerns for the years 1867–1929, the probability of a chance occurrence for a 9.14 year period to be only $P=1/1790$. Furthermore, by refinements (locating the period more accurately as 9.43 years), Greenstein reduces this value to $P=1/30700$ by Schuster's method, and to 1/5520 by Fisher's.[19]

While Greenstein himself is properly skeptical of the reality of the nine year period, the mathematical result obtained cannot be dismissed lightly as one of those cases in which a wrong result unfortunately creeps into the literature. This work was done under the direction of the late Henry Schultz at Chicago, and C. F. Roos[20] has stated that this paper by Greenstein is a "lucid description" of the Schuster technique for periodogram analysis. The fact seems to be that Greenstein used the best technique generally available to economists at the time he made his study.

Now Greenstein used Fisher's formula for his significance test, an this formula is derived on the assumption of *independence of successive ordinates*. That this condition is not satisfied by Greenstein's data is at once apparent from his periodogram in fig. 5, for to an unbiased observer this curve is not so much characterized by high values near nine years as by low values below six years. This is just as is to be expected if serial correlation is present, for this effect suppresses any high frequency oscillations, since successive values tend to be alike. We may therefore suspect that Bartels' result is the more nearly correct, especially since it agrees with our common sense judgment; but it would be of interest to attempt to correct for persistence in Fisher's formula so as to bring the results into better agreement. Thus we are again confronted with the problem of estimating in some way the number of independent components among any number of related ordinates.

Returning to Greenstein's data, since we have shown in fig. 3 that $d_\infty=2.5$ for this case, we divide the total number of items (66) by $d_\infty=2.5$ to obtain the number of "effectively independent items" (26). Using this value in Fisher's formula, we get

$$P_g = \tfrac{1}{2}(26-2)(1-g)^{\frac{1}{2}(26-2)} = 1/10 \tag{8}$$

and the embarrassing discrepancy between the results of Bartels' test and Fisher's test disappears. Thus both Bartels' and Fisher's formulas

[18] B. Greenstein, *Econometrica*, vol. 3, pp. 170–198, 1935.
[19] R. A. Fisher, *Proceedings Royal Society*, vol. 75, pp. 54–59, 1929.
[20] C. F. Roos, *Econometrica*, vol. 4, pp. 368–381, 1936.

give reasonable results when discreetly used. It may not be amiss however to point out that, as used by Greenstein, any desired increase in the significance of his nine year period could be obtained with Fisher's formula merely be recording monthly, daily, or hourly values of business failures over the time interval in question, for although Fisher's treatment remedied one defect in Schuster's method, he neglected to

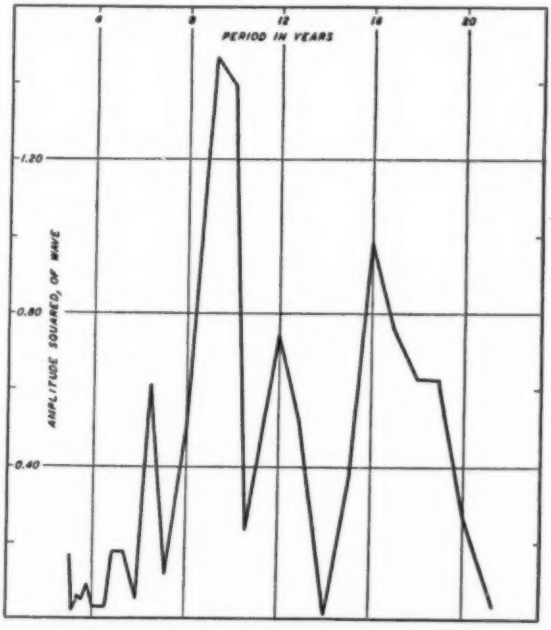

Fig. 5.—Periodogram for percentage ratios of business failures to total number of business concerns in United States, 1867–1932 (after Greenstein).

consider the overwhelming effect of a persistence tendency on the periodogram and its consequent effect on tests for reality.

It is a pleasure for the writer to acknowledge his indebtedness to Dr. W. Edwards Deming without whose continuous help and encouragement this paper would never have been written. The writer wishes also to express his gratitude to Mr. Stephan and many other friends and colleagues with whom he has discussed various aspects of the problems considered.

A NOTE ON THE CHI-SQUARE TEST, THE POISSON AND THE BINOMIAL

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In the September, 1938, issue of this Journal, I presented a number of instances of the application of the Pearson chi-square test in which the procedure led to difficulties of interpretation. In the same issue Professor Camp advanced some critical comments on the observations that I had made. To one of these, with regard to which I have recently completed some experiments, I should like to return.

The situation referred to was as follows: Five series, each containing 400 observations of the number of cells falling into the squares of a hemocytometer chamber, were examined for conformity with the Poisson distribution. The theoretic frequencies were calculated for a Poisson with the mean taken as that of the observed series, the Pearson chi-square was calculated as $\Sigma(o-t)^2/t$ and the P was ascertained for degrees of freedom equal to the number of groups utilized less two. The five chi-square P's thus evaluated, one for each series of 400 observations, were 0.77, 0.25, 0.94, 0.35, and 0.41. As is seen, in no instance did the P reach a value small enough to indicate a significant difference from the Poisson. More than 400 observations cannot be made in a single series because this is the number of squares contained in the entire hemocytometer chamber. However, one can examine the significance of the difference of the observations from the Poisson for the 2000 observations taken together by making a chi-square test utilizing the theorem that the sum of chi-squares is distributed as chi-square for the sum of the degrees of freedom. When this test was done utilizing the chi-square evaluations of the five series, the P obtained was 0.71, again indicating no significant difference from the Poisson, now on the basis of 2000 observations.

If we were really dealing with a Poisson, the mean (μ) would be equal to the variance (σ^2). However, on inspecting the sample values in the five series, it was found that in each instance $s^2 < m$. A test to determine whether the difference is significant can be obtained by using ns^2/m as chi-square with n degrees of freedom for the valuation of an appropriate P, where n is one less than the number of observations utilized in the calculation of s^2 and m. When the P was evaluated in this way for each of the five series, I obtained 0.14, 0.01, 0.94, 0.03, and 0.14. If we take 0.05 as the level of significance, we see that two of the five experiments, when tested in this way, indicated a significant dif-

ference from the Poisson. When the results of these five tests were put together for a test using the experience as a whole by again adding the chi-squares and the degrees of freedom, the evaluated P was <0.001. Utilizing this test, then, the observations showed clearly a significant difference from the Poisson.

Professor Camp explained the contradictory results on the basis of grouping (pp. 539–540). He argued that in performing the Pearson chi-square test, a grouping of the observed frequencies had been utilized, whereas in making the test with ns^2/m, the values of s^2 and m were obtained without any grouping of the observations. He contended that if the same grouping were employed in the latter text as in the Pearson chi-square test, the P values would be in general agreement. Under the circumstances of the experiment described, in his opinion the results obtained from the Pearson chi-square test were preferable, which is to say that he would accept the conclusion that the observations showed no significant difference from the Poisson. In this I believe he would be supported by many statistical authorities who place great reliance upon the chi-square test, but it is opposite from the conclusion which I, in the practical experiment from which the example was taken, actually did accept.

Now as a matter of fact, in the Pearson chi-square test as I made it, the unit of grouping utilized was the single blood cell, than which no finer grouping was possible, except at the extremities where, in order to conform to the rule that the Pearson chi-square test is valid only if in the expected category there is a minimum frequency of something like five, several of the frequencies were summed. Since the group at the upper extremity extends to infinity, how could the s^2 and m be calculated for this grouping in order to perform the ns^2/m test? What should be taken as the center of this group? I do not think there is any value that can be taken correctly. Be this as it may, as will appear from what is now to be presented, I do not think that the difference in grouping is the origin of the discrepancy of the results.

The theorems utilized in the determination of the P in both tests rest on the assumption of an indefinitely large series of samples from a Poisson distribution. If for each of such samples the Pearson chi-square test is performed and the P evaluated in the manner done in our experiment, a $P \gtrless 0.05$ will occur five times in a hundred. If, for these same samples, the P is evaluated from $ns^2/m =$ chi-square, as was done in the experiment, a $P \gtrless 0.05$ will also occur five times in a hundred. Under the circumstances of sampling from a Poisson, both tests will give, in a long series of applications, a rectangular distribution of P's

and hence the same frequency of any preassigned region of P although in any particular sample the two P's might be different. *This is true, differences of grouping notwithstanding.* It is for this reason that I say that the difference of grouping is not the reason for the difference of results in the two tests.

However, in the observations that were cited in the experiment, it was noted that in each series the observed s^2 was less than m. This suggested that we were dealing not with a Poisson distribution but with a Bernoullian, for in a binomial distribution, $\sigma^2 < \mu$. The average value of s^2/m for the five series was 0.89, and the mean 6.124. A least squares fit of a binomial $(p+q)^n$ to a series of observations sets $q = s^2/m$, and it therefore suggested itself that we were dealing with a binomial in the order of $(0.11+0.89)^{56}$.[1] The question then was prompted: Supposing we *were* dealing with this distribution—what would be the results of applying a test for the Poisson, on the one hand by way of the Pearson chi-square test as it was performed, and on the other hand by the ns^2/m chi-square test as it was performed? Would the P's obtained by both these tests, in a long series of samples from this binomial, yield the same distribution, even as they would if we were sampling from a Poisson? An adequate general answer to this question was beyond my mathematical abilities, and none of the mathematicians to whom I appealed seemed to have time for the problem. I therefore undertook to obtain an answer by means of an experiment as follows:

Utilizing a scheme for random experiments with punch-cards, the machinery for which will be described elsewhere, I obtained 20,000 random observations from the binomial universe $(0.11+0.89)^{56}$. These were taken in groups of 400 and the Pearson chi-square test for the Poisson and the test using ns^2/m were performed for each group, just as had been done in the original experiment. Five consecutive groups of 400 observations each were combined to obtain the two P's for the combined observations, again as had been done in the original experiment. The 20,000 observations yielded ten complete experiments of five series each.

In table I is given the P obtained for each test. We may distinguish four tests as having been performed: (1) the Pearson chi-square test performed on a series of 400 observations as it had been in the original experiment, which I shall symbolize $T_{1.1}$; (2) the test made by considering the sum of the chi-squares, as obtained from (1) for five of the series with the sum of the degrees of freedom, for the evaluation of a

[1] I do not mean that I assume that I was dealing literally with this binomial distribution in the sense that the p and the q and the exponent 56 had some physical meaning in the experiment, but only that descriptively the frequencies followed closely such a distribution.

chi-square P, which I shall symbolize $T_{1.2}$; (3) the test for whether s^2 and m are significantly different, made by evaluating ns^2/m in a series of 400 observations as chi-square and ascertaining the appropriate P, which I shall symbolize $T_{2.1}$, and (4) the summation of the chi-square values and degrees of freedom obtained in (3) for five series and ascertaining the appropriate P, which I shall symbolize $T_{2.2}$.

TABLE I

VALUES OF P OBTAINED FOR RANDOM SAMPLES FROM A BINOMIAL DISTRIBUTION USING TESTS FOR THE POISSON DESCRIBED IN THE TEXT. EACH NUMBERED EXPERIMENT CONTAINS 400 OBSERVATIONS

Exp. no.		1	2	3	4	5	6	7	8	9	10
P obtained from	$T_{1.1}$	.54	.67	.04	.73	.91	.03	.52	.02	.65	.27
	$T_{2.1}$	.74	.44	.04	.11	.30	.02	.26	.10	.32	.07
	$T_{1.2}$			.60					.03		
	$T_{2.2}$			.02					<.001		

Exp. no.		11	12	13	14	15	16	17	18	19	20
P obtained from	$T_{1.1}$	.77	.57	.25	.02	.06	.50	.96	.30	.16	.51
	$T_{2.1}$	.32	.16	.003	.002	.03	.12	.47	.01	.006	.65
	$T_{1.2}$			.05					.55		
	$T_{2.2}$			<.001					<.001		

Exp. no.		21	22	23	24	25	26	27	28	29	30
P obtained from	$T_{1.1}$	.04	.28	.29	.16	.65	.59	.43	.15	.35	.56
	$T_{2.1}$	.005	.28	.32	.13	.06	.16	.10	.59	.004	.12
	$T_{1.2}$			.07					.36		
	$T_{2.2}$			<.001					.002		

Exp. no.		31	32	33	34	35	36	37	38	39	40
P obtained from	$T_{1.1}$	.04	.01	.32	.57	.87	.42	.36	.08	.34	.15
	$T_{2.1}$	.07	.03	.81	.69	.38	.46	.31	.005	.22	.002
	$T_{1.2}$			.05					.09		
	$T_{2.2}$			.01					<.001		

Exp. no.		41	42	43	44	45	46	47	48	49	50
P obtained from	$T_{1.1}$	.27	.65	.66	.42	.04	.13	.40	.05	.06	.11
	$T_{2.1}$	.04	.19	.12	.01	.30	.12	.01	.001	.31	.02
	$T_{1.2}$			.25					.006		
	$T_{2.2}$			<.001					.001		

If we utilize as a level of significance $P \leqq 0.05$, I found that in the fifty samples of 400 observations each, $T_{1.1}$ correctly distinguished the distribution as not Poisson in nine cases, or 18 per cent of the times. In these same fifty samples of 400 observations each, $T_{2.1}$ correctly distinguished the distribution as not Poisson in seventeen cases, or 34

per cent of the times. In the ten series of 2000 observations each, $T_{1.2}$ correctly distinguished the distribution as not Poisson in four cases, or 40 per cent of the times. In the same ten series of 2000 observations each, $T_{2.2}$ distinguished correctly that the distribution was not Poisson in *all* the cases.

In the original experiment cited, we were dealing finally, on the one hand, with $T_{1.2}$, the Pearson chi-square test, and on the other hand with $T_{2.2}$, the results of which I accepted. If actually we were dealing with a binomial of the character here experimented with, so far as we can rely on an experiment with so few as ten samples, the present findings serve to explain the contradictory results obtained and favor the use of the ns^2/m test. The ns^2/m test would distinguish correctly that we were not dealing with a Poisson distribution in practically all instances, whereas the method of the Pearson chi-square test would fail in about 60 per cent of the cases if 0.05 is taken as the level of significance, and in about 90 per cent of the cases if 0.01 is taken as the level. It is notable moreover that if 0.01 is the limit of significance, $T_{2.1}$ (ns^2/m) which requires for performance 400 observations is on the basis of the findings in this experiment more efficient than $T_{1.2}$ (Pearson chi-square) which requires 2000 observations.

Those who are familiar with the writings of J. Neyman and E. Pearson regarding tests of significance will recognize that the approach used here for the analysis of this problem is along the lines advanced by them. What I have attempted to find out from a series of random samples—the probability of distinguishing as significantly different from the Poisson a sample drawn from a binomial—is directly related to the probability of committing what they call an "error of the second kind," (unity minus this probability). It is what they call the "power" of the test. Similar considerations have been discussed by Shewhart. I have deliberately avoided the terminology of these writers because, in the first place, I have arrived at this method of critical analysis independently, from experience with practical problems, and I should like my conclusions to serve for so little as they are worth as independent support of the methodology advanced by them. In the second place, my treatment here is only a very limited and partial application of a method of analysis which, with Neyman and Pearson, forms a generalized analytic procedure.

The undertaking to determine the probabilities of test functions, in random samples from distributions other than the distribution for which the test is made (the "null hypothesis"), initiated methodically by Neyman and Pearson is, I think, a fundamental departure in statis-

tical inquiry of great importance for practical work. Prior to the work of Neyman and Pearson, the sampling distribution of test functions was dealt with methodically for only one variety of distribution, namely, the distribution being tested for. About the results in samples from different distributions we remained in ignorance. Considered objectively, it seems odd to continue to apply a test the operational results of which we know only if it is applied to a situation which is, as a matter of fact, frequently not likely to occur. As an illustration, I may cite the fact that although the Pearson chi-square test was published in 1900 and although it has been perhaps one of the most widely utilized tests of significance, the very limited work here presented is the first published attempt, so far as I know, to determine quantitatively the probability of the Pearson chi-square P in a situation where the hypothesis tested does *not* obtain. I could hope that this presentation might serve as a stimulus for a more adequate and general treatment of the same problem.[2]

[2] Since writing this I have learned that Churchill Eisenhart has indicated a method for solving this problem (*Bull. Am. Math. Soc.*, Vol. 44, No. 1, Part 1, Jan. 1938, p. 32).

FURTHER COMMENTS ON BERKSON'S PROBLEM*

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The Editor has very kindly sent me the manuscript of Dr. Berkson's paper,[1] and has asked me whether I would like to reply to it. This article is in part such a reply, but the problem Dr. Berkson has considered seems to me to be an interesting one and to deserve further discussion on its own account rather than as a continuation of an argument. Therefore I would rather refer only incidentally to the question whether the words I used in my previous article, to which he alludes, are wholly correct. I have considered them again and do think they should remain as they are.[2]

This paper will begin with some preliminary remarks on the general theory of testing which it seems to the author ought to be set forth explicitly, although the material is not new. Then some reference will be made to what Berkson has just done in his paper, and finally some new mathematical material supplementing his work will be presented.

In developing a theory of testing we begin with a so-called "universe," which, in a simple case, is completely known, and we look at "all possible" samples that can be drawn from it. The universe may often be described approximately by a curve, such as the normal curve, and, in the simplest case, the sample is supposed obtained by drawing one individual at a time, with replacements, until the whole sample of say N individuals has been obtained. This sample may be denoted by $E(x_1, \cdots, x_N)$. E is commonly called a point in N-space. This language is helpful, and non-mathematicians should not avoid it on the spurious theory that the mathematician has some occult vision in this realm that the ordinary person does not possess. In order to conceive of N-space as well as the mathematician does, all you have to do is to conceive of three-way space and then use the same words for N-space. You will not know whether or not the words are correctly used until you have checked them with algebraic formulae later on; neither does he. Now all possible samples may be divided into two groups, sometimes called the good and the bad samples, or the ordinary and the extreme samples, or the credible and the incredible. It is important to remember that all these samples are possible, even if called incredible. We clothe this separation in geometrical language by saying that we draw a contour in sample space (the N-space in which the E's are located), and outside it we find the one sort of sample and inside it the

[1] This Journal, Vol. 35, pp. 362-367.
[2] This Journal, Vol. 33, pp. 539, 540.

other sort. Usually the extreme samples are said to be on the outside, although this word "outside" is not clearly defined; and the contour is commonly drawn so that the total probability of all samples on the outside is less than some small number, such as 0.01. All this is done in order that we may construct a test by which we may decide whether to make the judgment that the sample observed did come from the universe being considered. We commonly reject this hypothesis if our observed sample belongs to the extreme class.

There are an infinite variety of such contours, each of which separates off one per cent of the samples, and different tests correspond to these different contours. Let us consider some of them.

(*a*) We may make a "contour of constant probability"; this passes through all those sample points which have the same probability. Then we have on the outside only samples of smaller probability, on the inside only samples of greater probability. This method is utilized in the chi-square test, and in many other simple tests.

(*b*) We may make a "contour of constant λ" (λ to be defined). This passes through all those sample points which have the same λ; on the outside are only the samples whose λ's are smaller, on the inside only those whose λ's are larger. The quantity λ is a fraction, whose numerator is the probability of the observered sample if drawn from the universe being examined, and whose denominator is its probability if drawn from that one of the other possible universes which is most favorable to it. This leads to so-called λ tests; in some of the simpler cases these turn out to be not different from the corresponding tests obtained by (*a*).

(*c*) We may choose our contour so that so far as possible the sample point E shall always be on the outside when as a matter of fact it is not produced by the universe being investigated. The more effectively this is done the more "power" the corresponding test is said to have. This is a sound idea and has recently become popular. It is, however, difficult to apply in most cases.

(*d*) Instead of considering the sample E itself, that is the set of measurements $x_1, \cdots, x_N$, we may consider instead some function F of these measurements, such as their mean, or standard deviation, and then draw our contour so that it separates off samples for which F is extreme in some sense. We might for example, as in (*a*), say that F was extreme if its probability was relatively small. The frequency distribution in which the measurements may be grouped is another illustration of such a function. Another is chi-square, and it happens that the chi-square test is so constructed that, with due allowance for approximations, the contour which separates off the extreme chi-squares is the same

one as that which separates off the extreme distributions. This is why the chi-square test has a strong appeal intuitively to most of us. If one does not know or keep track of the individuals as the sample is drawn, one at a time, but knows only the number of individuals of each kind, that is, if one knows only the frequency distribution of the sample, then one would usually prefer to use a function which was thus closely related to the probability of the distribution itself, rather than one which was not so related. This was the sense, and the only sense, in which the author said in his other paper that the chi-square test was to be preferred to a test based on some such function as the variance of a sample. He did not indicate that it has more "power," in a case such as Dr. Berkson now investigates, and for the very good reason that, so far as he knew, nothing had been done on that subject in that connection, and accordingly he knew nothing about it.

Dr. Berkson now holds that he has shown, statistically, that the test based on ns^2/m has more power than the chi-square test when the universe initially under consideration is a certain Poisson sequence, and when the only other alternative universe is a certain point binomial. The Poisson sequence chosen is that one whose mean equals the mean of the sample; the point binomial is fixed and is chosen in a special way connected with the practical work in which Dr. Berkson is engaged. This author agrees that this has been shown in a convincing manner. In general it is difficult to solve these questions of power mathematically, and the statistical approach is then obviously necessary. In fact, as Dr. Berkson also implies, his case is pretty strong *a priori*, for one would be pretty sure, before making the samplings, that they would turn out that way, if one compared the given point binomial $(.89+.11)^{56}$ with the Poisson which has the same mean. The differences between the terms of these two series are all of one sign at the two ends, and all of the other sign at the middle. This means that the variances of the two are much more different than they would be if the variation in sign were irregular; but that the value of chi-square is not greater on that account. The order in which the various terms are arranged does not affect chi-square, except indirectly in that the more distant terms are associated with small probabilities. But the order of arrangement does affect the variance decisively. Now consider what sort of samples we may expect. Most samples may be supposed to be like their parent. For those that resemble very closely this point binomial the value of chi-square is about equal to 2.37, corresponding to $P=0.996$ for the Poisson hypothesis, while the value of ns^2/m is about equal to 356, corresponding to $P=0.12$. This makes it clear that the two frequency distributions differ from each other much less than

do their second moments (or, what is about the same in this case, their indices of dispersion ns^2/m).[3]

But there is a still better reason for preferring a test based on ns^2/m; this test which will be described is not exactly the one Dr. Berkson uses but it is not very different from it. When, as here, there are but two "simple" alternative hypotheses, it is a known theorem of the power theory that the contour which separates off the best critical region, relative to each hypothesis, is one where $P_0/P_1 = k$, P_0 being the probability of the sample on hypothesis H_0 and P_1 its probability on hypothesis H_1, k being some constant. We shall show that, subject to certain restrictions, these contours are in our case also contours on which $P_0'/P_1' = k$, where P_0' is the probability of ns^2/m from H_0, and P_1' is its probability from H_1; but a similar remark cannot be made for chi-square. Hence, subject to the restrictions (which are not severe) and to the interpretations which will be made later (Example 2), the boundary of the best critical region is one of those for which $P_0'/P_1' = k$. So far as the author knows, this theory does not specify the best value of k to choose if one is interested merely in deciding between H_0 and H_1, and if one does not insist on a specified maximum chance of improperly rejecting one of these hypotheses. The principle of likelihood would indicate the use of $k = 1$ in such a case, and this principle also has a strong appeal to the intuition. A fault of the principle of likelihood when used in this manner is that it does pre-suppose that the *a priori* probabilities of the two hypotheses are the same. This remark also applies to the power device.[4]

As a supplement to Dr. Berkson's work, therefore, rather than as a criticism of it, the remainder of this paper will be devoted to a consideration of the principle of likelihood as applied to his data, and to similar questions. First let us limit more closely the meaning of $E(x_1, \cdots, x_N)$. We now suppose this to be a sample from a point binomial of the form,

$$(1) \qquad (p + q)^r = p^r + \cdots + {}_NC_t p^{N-t} q^t + \cdots + q^r;$$

x_i is the value of t which the ith individual drawn is found to have, $i = 1, \cdots, 400$. The frequency distribution F of E shall be denoted by $t_j, f_j, j = 0, \cdots, r$. The mean $\bar{t}$ of this frequency distribution is identi-

[3] The point about there being only 12 categories in one test and more in the other is also pertinent here, but not as important as it was in the example the author discussed in his other paper. In most of *these* cases there will probably be found to be large differences between the observed and expected s^2 even if only 12 categories are considered in both sample and the Poisson universe. The general remark that chi-square applies to areas rather than to a continuous curve is relevant to both situations.

[4] This difficulty can be surmounted in certain cases. "The testing of statistical hypotheses in relation to probabilities *a priori*," by J. Neyman and E. S. Pearson, *Proceedings of the Cambridge Philosophical Society*, vol. 29 (1933), pp. 492–510.

cal with the mean $\bar{x}$ of the sample, and the same applies to their other moments. We shall use Berkson's notation,

$$ns^2 = \sum_1^N (x_i - \bar{x})^2, \qquad n = N - 1, \qquad \bar{x} = m.$$

Consider now the relative likelihoods of the following hypotheses: H_0 that E was obtained from a point binomial having the mean m and in which $p = p_0$, and $r = r_0$; H_1 that E was obtained from a point binomial with the corresponding parameters m, p_1, r_1. This is a more general problem than Dr. Berkson's in that two binomials are involved; it is not necessary that one should be a Poisson. As a special case we shall also consider the limiting case $p_1 = 1$, $r_1 = \infty$, in which the second point binomial does become a Poisson. This special problem is still slightly different from Dr. Berkson's, because we are requiring not only that the Poisson but also that the point binomial shall have the same means as the observed sample.

Now let $P(E|H_0)$ denote the probability of E from H_0, $P(E|H_1)$ its probability from H_1; and employ similar notations for the probabilities of the frequency distribution F observed in E and for the probabilities of the observed ns^2/m, viz., $P(F|H_0)$, $P(F|H_1)$; $P(ns^2/m|H_0)$, $P(ns^2/m|H_1)$. We shall prove that

$$P(E \mid H_0)/P(E \mid H_1) = P(F \mid H_0)/P(F \mid H_1),$$

and, subject to the approximations to be stated, that each of these equals

$$P(ns^2/m \mid H_0)/P(ns^2/m \mid H_1).$$

These proofs will justify the statement made earlier to the effect that the contours on which the first of these ratios is constant are the same as the contours on which the last is constant, and the conclusion that the best critical region, and therefore the most powerful test, is determined by a contour where the last ratio is constant. As stated before we shall consider only that contour on which this ratio equals unity, thus making use of the principle of likelihood. We shall compute later (Example 3) the powers of the tests thus obtained.

Proof. Let the successive terms of the point binomial (1) be denoted by $\phi_0, \phi_1, \cdots$ under the hypothesis H_0 that $p = p_0$ and $r = r_0$; and by $\psi_0, \psi_1, \cdots$ in the other case H_1 where $p = p_1$ and $r = r_1$. The number of terms is (r_0+1) in the first and (r_1+1) in the second. Let $(r+1)$ be the number of different values of t in the sample E. In general $(r+1)$ will be at most (r_0+1) and also at most (r_1+1), and in what follows it will be assumed that this is always the case; for otherwise no test is

needed. For example, if the sample contained an individual for which t was so large that it could not have come from the one of these universes but might have come from the other, then obviously the true universe would be definitely designated. By elementary probability theory

$$(2) \qquad P(E \mid H_0)/P(E \mid H_1) = \phi_0^{f_0}\phi_1^{f_1} \cdots \phi_r^{f_r}/\psi_0^{f_0}\psi_1^{f_1} \cdots \psi_r^{f_r}.$$

Also

$$(3) \qquad P(F \mid H_0)/P(F \mid H_1) = C\phi_0^{f_0}\phi_1^{f_1} \cdots \phi_r^{f_r}/C\psi_0^{f_0}\psi_1^{f_1} \cdots \psi_r^{f_r},$$

where

$$C = N!/(f_0!f_1! \cdots f_r!), \qquad N = f_0 + f_1 + \cdots + f_r.$$

Thus we have a case in which the relative likelihood has the same value whether the event observed is the sample E itself or a certain function F of that sample. This will not be true of all functions of the sample, and it is not true for chi-square, although it is true for certain general classes of functions. In order to prove it now for the function ns^2/m we shall have to approximate ϕ and ψ by their best fitting normal laws, for it is not true for this function exactly. The error due to this approximation will be illustrated in Example 1.

Accordingly, we now find the probability $P(E|H_2)$ that E would be obtained if H_2 the universe were normal with a mean equal to $\bar{x}$ and standard deviation equal to σ_0. Since this is a continuous universe we have to use, instead of the probability ordinate $P(E|H_2)$ the probability density; that is, this ordinate times an element dX of the space in which E lies:

$$(4) \qquad P(E \mid H_2)dX = \frac{dX}{(\sigma_0\sqrt{2\pi})^N} \exp \frac{-1}{2\sigma_0^2} \sum_1^N (x_i - \bar{x})^2,$$

$$dX = dx_1 \cdots dx_N.$$

This means that after E has been found we fix our attention on the normal universe whose mean is the observed $\bar{x}$, and whose standard deviation is σ_0, and then consider all samples that can be obtained from it, including those whose means are not $\bar{x}$. An equation similar to (4) may now be written for the probability $P(E|H_3)$ that E would be obtained if H_3 the universe were one whose mean was $\bar{x}$ and whose standard deviation was σ_1. Writing the sum in (4) in the equivalent form ns^2, we have as the relative likelihood of H_2 and H_3:

$$(5) \qquad \frac{P(E \mid H_2)}{P(E \mid H_3)} = \left(\frac{\sigma_1}{\sigma_0}\right)^N \exp - \frac{ns^2}{2}\left(\frac{1}{\sigma_0^2} - \frac{1}{\sigma_1^2}\right),$$

where ns^2 has the value observed in the sample E. Now consider all samples x_i of size N from H_2, including those whose means are not m, and find the distributions of z, where $z=\Sigma(x_i-m)^2$, and of y, where $y=z/m$. It is known that the distribution of z is:

$$(6) \qquad D(z)dz = az^{\frac{1}{2}N-1}\exp -\frac{z}{2\sigma_0^2}dz, \quad a=\frac{1}{(2\sigma_0^2)^{\frac{1}{2}N}\Gamma(\frac{1}{2}N)};$$

and therefore the distribution of y, m being a constant, is

$$(7) \qquad D(y)dy = ky^{\frac{1}{2}N-1}\exp -\frac{my}{2\sigma_0^2}dy, \qquad k=am^{\frac{1}{2}N}.$$

This is the probability density of y. Hence the relative likelihood of obtaining the observed $y(y=ns^2/m)$ from H_2 and H_3 is:

$$(8) \qquad \frac{P(y\mid H_2)}{P(y\mid H_3)}=\left(\frac{\sigma_1}{\sigma_0}\right)^N\exp -\frac{my}{2}\left(\frac{1}{\sigma_0^2}-\frac{1}{\sigma_1^2}\right),$$

which is the same as (5).

Now let us put $\sigma_0^2=p_0\bar{x}$, $\sigma_1^2=p_1\bar{x}$, so as to bring the notation into agreement with that used in (1), and so as to specify the normal curves as the ones which fit the point binomials. Then (5) and (8) may be written in the equivalent form:

$$(9) \qquad \frac{P(y\mid H_2)}{P(y\mid H_3)}=\frac{P(E\mid H_2)}{P(E\mid H_3)}=\left(\frac{p_1}{p_0}\right)^{\frac{1}{2}N}\exp -\frac{ns^2}{2m}\left(\frac{1}{p_0}-\frac{1}{p_1}\right),$$

and, with due allowance for the approximations used, these fractions are also equal to

$$P(E\mid H_0)/P(E\mid H_1).$$

Next we consider the special case $p_1=1$, $r_1=\infty$, which makes the second point binomial go over into a Poisson whose mean is also the m observed. Then

$$(10) \qquad \frac{P(E\mid H_0)}{P(E\mid H_1)}=\left(\frac{1}{p_0}\right)^{\frac{1}{2}N}\exp -\frac{ns^2}{2m}\left(\frac{1}{p_0}-1\right).$$

Example 1. Using Berkson's values, $N=400$, $p_0=0.89$, find the critical value of ns^2/m that distinguishes samples for which H_0 would be acceptable from those for which it would not.

If H_0 is acceptable, $P(E\mid H_0)\geqq P(E\mid H_1)$; hence

$$\left(\frac{1}{.89}\right)^{200}\exp -\frac{ns^2}{2m}\left(\frac{1}{.89}-1\right)\geqq 1, \quad \text{and so} \quad ns^2/m\leqq 377.15.$$

It is now worth noting that, if we had used only ordinary common sense in solving this problem, without any of the mathematical theory, we might have arrived at almost the same conclusion. For we might have said that, in choosing between the point binomial and the Poisson, we would accept that one whose variance was nearer to the variance of the observed sample. Then the critical value of ns^2/m would have been 377.06. However, if in using such a method we had happened to think in terms of the standard deviation (square root of variance) instead of the variance, the critical value would have turned out to be 376.7; and so we would have had to decide which common-sense method was the better, and would have been led naturally to some such theory as the one actually used.

Example 2. Compute the power of this ns^2/m (likelihood) test as applied, first to H_0 and then to H_1, if $m=6.16$.

It is necessary to state first exactly what the conditions that have been imposed imply. We suppose that a sample is observed to have a mean, $m=6.16$. Then the binomial series for which $\bar{x}=6.16$ becomes the universe in H_0, and the Poisson series for which $m=6.16$ becomes the universe in H_1. The test then states that, if a sample is known to be from one or the other of these specified universes, it is to be ascribed to the one or the other according as its own ns^2/m is less than or greater than 377.2. Such samples have a variety of means.

By (7) the probability that a sample from this point binomial would lie in the interval for which $0 \leqq ns^2/m \leqq 377.2$ is

$$\int_0^{377.2} ky^{\frac{1}{2}N-1} \exp -\frac{my}{2\sigma_0^2}\, dy = 0.80. \qquad (a)$$

The corresponding probability from this Poisson is

$$\int_0^{377.2} ky^{\frac{1}{2}N-1} e^{-\frac{1}{2}y} dy = 0.21. \qquad (b)$$

The test indicates that we should reject H_0 if the sample is not in the interval stated. So, relative to H_0 the probability of an error of the first kind is by (a) equal to 0.20, and by (b) the probability of an error of the second kind is 0.21, so that the power is 0.79. Similarly, relative to H_1, the probability of an error of the first kind is by (b) equal to 0.21, since now the interval stated is the one where the Poisson is to be rejected, and by (a) the probability of an error of the second kind is 0.20, yielding a power of 0.80.

FINAL COMMENT

Professor Camp considerately has allowed me to see his comments prior to their publication, and his first paragraph prompts me to make a brief statement in connection with what he says there. Pro-

fessor Camp implies that the differences between us are verbal and that if his first article were correctly read, there would be no issue between us of any interest to the reader. This is different from my own concept of the situation. There is a definite and important issue. It is not between Professor Camp and myself, for I think Professor Camp's viewpoint is the orthodox one as reflected in general statistical texts, and as I have found it in my discussions with most other statisticians. The difficulty that I have in following this viewpoint is that I find that the arguments at certain crucial points are *meaningless*, in the technical operational sense of the word; that is, they are vague and/or equivocal in indicating what should be *done* or what conclusions should actually be *accepted* in certain statistical situations. It is for this reason that I clutch so tenaciously at a concrete real problem where the issue may be seen in practical terms, and that is why I think it would be unfortunate to allow the issue to be lost now.

I had the concrete problem of trying to determine whether the blood cells in a hemocytometer chamber could be considered to follow the Poisson distribution. Upon the decision depended all the further work to be done in the problem. "Student," in his classic article "On the Error of Counting With a Haemacytometer," *Biometrika*, 5: 351–360, 1906–1907, had exactly this same problem for yeast cells. He applied the chi-square test and found no significant difference. I applied the chi-square test to my data and found no significant difference. This is the test and the manner of performing it that the statistical texts at present teach. This is the test and the conclusions for the problem in hand that I understood Professor Camp was defending and advocating. *I did not* accept it. My reasons and a partial analysis of the fundamental logical problem involved were contained in my paper. There is an issue which is of import to anyone who, like myself, is interested in the application of statistics. I may attempt to crystallize it now this way. Would Professor Camp counsel one of his pupils with a similar problem to use and abide by the results of the chi-square test as "Student" did? Or would he now say that the chi-square test was inadequate in that situation? If he would approve, then I have not misread his article; if he would not, then we have made some progress. What I fear is that under his theory it may be possible to do neither. For myself, I say unequivocally that "Student's" test was inadequate and further that this is only an illustration of a general weakness which resides in the chi-square test. J.B.

Dr. Berkson's direct question seems to require a direct answer. In the terminology of my following paper I think his question may be put this way. The universe being tested is described by a specified Poisson sequence; a sample point E is found to lie in the region called extreme by the chi-square test; was the universe truly Poisson? I do not know. So far as I can see there is no way of knowing, if the sample was in fact one that was *possible* under the Poisson hypothesis. As indicated in my paper, there are an infinite number of extreme regions that might be chosen for rejection purposes, and of these the chi-square region is only one. *If* the only alternative hypothesis is as in our two papers, then of these regions I would not personally choose the chi-square region in preference to the one based on variance, but I could conceive of cases in which the reverse would be true. I would choose the other region in this case because I would prefer the power theory when it can be applied. But it must be recognized that a choice even of the power theory is a matter of preference; there is nothing logically compelling about it; it rests on a purely pragmatic philosophy, namely, that if one uses it consistently one will presumably make less errors "in the long run" than if one does not. The word "presumably" is needed here, for it is quite possible that everbody will make an error every time he uses it. B. H. C.

NOTES

CONSISTENCY OF INFORMATION FROM RECORDS AND INTERVIEWS

During the past decade, the needs of various Federal and local governmental agencies have given great impetus to the collection of social and economic data by means of interviews with individuals affected by the agencies' activities. In order to guide policy, it has been necessary to secure directly information not only about the present status of such persons but also about their own history or that of their families. For example, the date at which a relief applicant lost his last job and the nature of the job are essential items of information for the administrator of a work program along with knowledge of the applicant's current income and extent of need. Generalizations on the basis of many such responses are also of fundamental importance for administrative planning.

It has rarely been feasible to make objective tests of the accuracy of data secured directly from respondents, although such tests are of scientific value in measuring the reliability of information obtained by personal interview. From time to time, however, various types of checks have been used. Perhaps that adopted on the widest scale was the Enumerative Check Census of Unemployment and Partial Employment[1] in November 1937 in which a sample of postal routes was drawn and interviews conducted to provide data for comparison with information submitted voluntarily by mail in the complete registration. Only in a small sample of the check routes were data for identical individuals compared however. Another type of verification of statistical data is the re-interview in order to ask the same questions of the same or another member in the families originally visited. Use was made of this procedure by Dr. Gladys L. Palmer in the 1937 survey of employment and unemployment in Philadelphia.[2] Still another method has been used to check occupational returns, that is, comparison of an employer's description of a worker's job with the worker's own statement as to the nature of his job. This type of verification was applied to a sample of the returns secured in the 1938 survey of employment and unemployment in Philadelphia in order to provide in-

[1] Census of Partial Employment, Unemployment and Occupations: 1937, Final Report on Total and Partial Unemployment, Volume IV, *The Enumerative Check Census.*

[2] *Employment and Unemployment in Philadelphia in 1936 and 1937, Part II: May 1937,* WPA National Research Project and Industrial Research Department, University of Pennsylvania, Appendix A.

formation for the use of the Bureau of Old Age Insurance of the Social Security Board.[3]

Verification by all three of the methods noted is to some extent inconclusive in that the second set of data used for check purposes may be as unreliable as the first, and may err in the same or in the opposite direction since some of the factors making for fallibility are present at both times. Nevertheless such methods indicate the kinds of information in which accuracy, or at least the same type of answer, may be expected, and are in many cases the only kinds of check possible to apply.

The questions asked at interview may also be answered by analysis of records. Unfortunately certain obvious difficulties are always encountered in clearing a set of names through a record file and the time and cost involved frequently make the procedure impractical. For example, changes of names or different spelling of names in conjunction with changes of address between the date of filling the record and the date of interview may make it impossible to be sure of the identity of the family for whom the information is desired. Changes in family composition also create difficulties in this connection since the record in question may be filed under the name of a person no longer in the family as constituted at interview. If the file of records is large the process of searching and verification is tedious and never entirely conclusive. Nevertheless, when the records are up to date and have been accurately maintained, this method has produced results sufficiently valuable to warrant its use when time and funds allow.

The Division of Research of the Work Projects Administration has adopted this procedure in a number of its surveys, chiefly in connection with verification of data on relief history. In a recent survey of unemployment in Philadelphia,[4] information was secured at interview on two questions for which it was possible to obtain answers from public records as well: Date of latest relief grant for certain types of families characterized by the existence of unemployment or part-time employment, and date of latest registration at the State Employment Office for each worker.

As part of the survey, the name and other identifying information of each family interviewed were cleared through the general assistance files of the Department of Public Assistance. This check was made to

[3] Wood, Katherine D., "The Statistical Adequacy of Employers' Occupational Records," *Social Security Bulletin*, Social Security Board, May 1939.

[4] The survey was conducted in February and March 1939, by the Division of Research in cooperation with Dr. Gladys Palmer of the Industrial Research Department of the University of Pennsylvania. A one per cent sample of the households in the city was interviewed.

ascertain whether the family had ever received relief and to determine the degree of consistency between the responses obtained at interview and similar information provided by the records. Two sets of the general assistance files were examined, the currently active file of February 1939 and the inactive file covering the period October 1936 through January 1939. As experience with the check of the latter file clearly indicated, a search of the inactive file for the period prior to October 1936 would have been cumbersome and unreliable. The difficulties encountered in identifying families whose name, address and family composition had changed would have been greatly enhanced since a search of the entire file involved dealing with approximately half a million record cards. There are 1,595 families for which information on receipt of relief was obtained from interview. On the basis of this check, which was complete for February 1939, 533 of the 1,595 families were found to be currently receiving relief (see Table 1).

TABLE 1

COMPARISON OF INFORMATION ON FAMILY RELIEF STATUS SECURED FROM RECORDS AND FROM INTERVIEWS,* SURVEY OF UNEMPLOYMENT, PHILADELPHIA, FEBRUARY-MARCH 1939

Comparison of information on relief status of family from records and interview	Number of families	Per cent
Family active on relief February 1939, according to records	533	100
Active February 1939, according to interview	491	92
Latest relief grant prior to February 1939, according to interview	27	5
Never received relief, according to interview	15	3
Family received latest relief grant after September 1936 but prior to February 1939, according to records	235	100
Latest relief grant prior to February 1939, according to interview	194	83
Active in February 1939 or never received relief, according to interview	41	17
Family received no relief after September 1936, according to records	827	100
Never received relief, according to interview	698	84
Active on relief at some time, according to interview	129	16

* The figures in this table are based on information for 1,595 families for which information on relief experience was obtained by interview.

For the most part, respondents provided information consistent with the records as to whether or not they were currently on relief in February 1939, and if not, whether they had formerly received relief. Only 5 per cent of the families currently on relief had told the enumerators that they were no longer receiving relief and only 3 per cent of the families said they had never received relief. Although the difference in returns was greater on the question of past relief status, a very substantial amount of agreement was revealed by the check. Over four-fifths of the responses from families for which the records

showed date of latest relief grant during the period October 1936 through January 1939 were consistent with the record information in that they had, at some time prior to February 1939, been active on relief but that they no longer received such assistance. However, comparison of actual dates of latest grant, where possible,[5] shows that not much reliance can be placed on information of this type given by family members at interview when the family is not currently on relief.[6] Sixteen per cent of the families for which no record of a relief grant was found stated at interview that they had at some time been active on relief. The percentage of disagreement would doubtless have been smaller if the process of searching the files could have been prolonged to include the inactive file for the period prior to October 1936.

Information secured at interview with regard to registration of individual workers with the State Employment Service was checked with the Employment Service records. The files were carefully searched to determine whether or not the unemployed or part-time employed workers included in the survey had ever been registered and, if so, their latest registration date. Obviously failure to find an individual's name in either the active or inactive files had to be considered evidence of lack of registration. About one-fifth of the workers checked were found to be actively registered with the service.

Comparison of information from the two sources is possible for 2,964 persons. There was a fairly high degree of consistency between record information and that secured by the interviewer on the broad question of whether or not family members had ever been registered with the

TABLE 2

COMPARISON OF INFORMATION ON EMPLOYMENT SERVICE REGISTRATION SECURED FROM RECORDS AND FROM INTERVIEW, SURVEY OF UNEMPLOYMENT, PHILADELPHIA, FEBRUARY-MARCH 1939

Registration status according to records	Registration status according to interview					
	Total		Same as records		Different from records	
	Number	Per cent	Number	Per cent	Number	Per cent
Total workers	2,964	100	2,268	77	696	23
Worker registered at some time	1,634	100	1,326	81	308	19
Worker never registered	1,330	100	942	71	388	29

[5] Since the actual dates of latest relief grants to families not active on relief in February 1939 were available both from records and interview for only a relatively small number of families, no comparison of these dates is presented.

[6] This result is consistent with the findings of Dr. Palmer from her comparison of first and second interview data, i.e., that the least reliable returns were those involving dates and periods of time. Op. cit., p. 3.

State Employment Office. Seventy-seven per cent of the answers agreed with recorded information in this respect (Table 2). On the other hand, when the recorded dates of latest registration are compared with the respondents' dates for workers registered relatively recently (since January 1938), only 25 per cent were found to be in the same month and 18 per cent differed by more than 6 months (Table 3). No registration had been claimed for as many as one-sixth of these names found in the files.

TABLE 3

COMPARISON OF INFORMATION ON DATE OF LATEST EMPLOYMENT SERVICE REGISTRATION SECURED FROM RECORDS AND FROM INTERVIEW, FOR WORKERS REGISTERED SINCE JANUARY 1938 ACCORDING TO RECORDS, SURVEY OF UNEMPLOYMENT, PHILADELPHIA, FEBRUARY-MARCH 1939

Difference between record and interview registration date	Number of workers	Per cent
Total workers registered since January 1938 according to records	1,142	100
Record and interview date same month	290	25
Difference of 1 month	179	16
Difference of 2 months	68	6
Difference of 3 months	71	6
Difference of 4–6 months	95	8
Difference of more than 6 months	206	18
Difference not ascertainable	42	4
Worker never registered, according to interview	191	17

As might be expected, these data indicate that the majority of respondents tend to give information consistent with that from an independent source on the more general questions of present or past status, but not on specific items such as dates. Moreover, the person interviewed, frequently the housewife, is apparently more likely to give accurate information on an important item of family status such as relief than on questions concerning activities of individual members of the family such as registration at a specific agency. It should be remembered that the degree of consistency found here is also a function of the amount of time spent searching record files, as it would be in any such comparison. For this particular survey, the results of these checks were significant in the interpretation of the findings; they may be useful in other surveys in which checking of field data is not feasible.

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CAN SAFETY BE HANDLED STATISTICALLY?

(A Statistician's Appraisal of Safety Statistics)

There is definitely an important role for statistics in the field of safety activities. Anyone who reads the early history of the safety movement will readily understand that adequate accident statistics is part of the groundwork for successful safety work. The basic approach toward effective accident prevention activities, however, will probably of necessity remain the case history approach, despite the type of statistical procedure developed.

To ask statistics to shoulder too great a responsibility will in the long run undermine the faith of safety engineers in a profession which otherwise has much to offer to the field of safety. The present article is written with the idea in mind that too much is often expected from the science of statistics. The very ones who overwork it are those who ultimately condemn it.

Few people will deny that the problems of accident causation are manifold and challenging. Practically all will agree that past records and experience in the field of accident and injury prevention have always been valuable, and in fact indispensable. But not all are in agreement, apparently, as to the basic methodology of approach to the problems of safety. There is a recent tendency, it seems, to place undue importance on the collection and dissemination of statistical facts concerning accidents and injuries, and too little stress on the need for the case history method. In other words, there appear to be too many volumes of statistical data, and not enough actual inspections of a preventive nature at the point of operation.

Can safety be handled statistically, or more specifically, to what extent and with what reliance can accident prevention programs be so handled? It is the opinion of the writer that accident prevention activities can at best rely on statistical studies to but a limited degree. Speaking as a statistician, I believe that the most we can hope from statistics in learning about causes of accidents, is a verification of the validity of approach used by the safety engineer in attacking certain hazards. Statistics may give the safety engineer certain clues, they may clarify certain assumptions, they may stimulate a praiseworthy inquisitiveness and scientific skepticism, but if forced beyond these valuable yet broad usages, statistics may prove more misleading than helpful. This appears particularly true as the field measured becomes larger and larger. For example, safety endeavors of the States and Federal Government might well rely more on personal inspections and investigations and less on voluminous reports, statistically handled, and little verified as to the validity and correctness of reporting.

The same seems true but to a much more limited extent in most industrial fields. The statistician is prone to make hair-line distinctions in the coding of accident or injury reports which in themselves do not actually permit such distinctions. Try, for instance, to ascertain from the average injury case, whether the unsafe act was due to safety devices being inoperative because of mechanical defect, or to their having been made inoperative by the operator. Or try to distinguish in many cases between the unsafe act of overloading, that of crowding, or that of improper planning. Moreover, numerous important accidents and injuries defy statistical handling as to minutely divided and specific cause factors. These are often in the field of infected eye injuries following alleged foreign body in the eye; back injuries; hernias; and unwitnessed fatal accidents. It is difficult enough to try to distinguish between a natural condition of disease and that of accidental or even purposeful injury, no less attempt to break their causes into component parts as is recently being recommended.

Theoretically, the proposed approach to the coding of accident causes as promulgated by the American Standards Association is parallel to an actual investigation of a case by a safety engineer. This assumes a reporting system of a nicety which at present does not exist, although admittedly it should be made to exist. But even if it did exist, however great the improvement in the form of our statistics on causes, certain basic limitations to the statistical approach must be faced. In appraising the alleged need for a new method of coding accident causes it is even reasonable to hazard the opinion that the old cause of injury code in the past has been utilized too infrequently or too hastily interpreted, when in many instances it might prove to be just as enlightening concerning the basic cause factors as is the newly recommended cause of accident code system.

The old cause of injury code if used in juxtaposition to the nature, location, extent, and costs of accidental injury, yields valuable material both for the safety engineer and administrator of compensation procedures. Such an approach might even be superior to the proposed code which during its experimental stage appears without even distinguishing whether the reported injuries are nonfatal or fatal; natural diseases or traumas. Both methods of coding must face the dilemma that they prove valuable in proportion to the specific nature of the industrial field to which they are applied, but prove statistically unreliable in many investigations for this very reason, inasmuch as there often is a dearth of statistical material pertaining specifically to that field. Whether such broad statistical results as are obtainable are interchangeable for fields of endeavor somewhat similar in nature is often

problematical. Are the accident cause factors found by coding W. P. A. construction injury reports of a particular town the same as those affecting construction in general in that town? They are probably similar, but are undoubtedly so with numerous qualifications. Many towns are too small, or private construction too limited to get numerous enough observations to answer both problems statistically.

Little stressed in recent articles, yet carefully reiterated in reports from the American Standards Association and the National Safety Council, are the poor reporting forms and procedures upon which both systems of coding must at present apparently rely. Three notable exceptions which come to mind are the U. S. Employees' Compensation Commission's cause of fatal injury supplementary report, the Federal Bureau of Motor Carriers vehicular accident report, and the cause of accident reports of the State of Pennsylvania. Moreover, even if detailed and accurate reports are obtainable, it is too often forgotten that statistical results are but numerical chronicles of an historical nature, often reflecting conditions and factors taken care of immediately at the source of accident under a system of scientific investigation and follow-up.

It is the belief of the writer that a more thorough system of administrative control, aided by broad statistical inquiries, to insure adequate and thorough safety inspections of a preventive nature, would be more valuable than all the figures on accident or injury causation one could at present marshall from all of the States. Just as the fields of rehabilitation and compensation have been found to be limited largely to the personal case history approach, it is quite probable that safety engineering, although fortified by broad statistical studies, is primarily dependent upon individual facts to be gleaned from each point of operation. The more one relies on statistical averages for specific methods of approach, the more prone one is to getting average results rather than scientific safety.

The writer does not wish to convey the idea that improvement in the statistical approach to safety is not at this time a commendable attempt to be of service to the safety engineer; but he does wish to call attention to the fact that, however beneficial, the new statistical tool will be no panacea in the field of accident prevention. The newly recommended coding procedure for recording causes of accidents will no doubt be an improvement over the old in many respects, but its application will be successful only to the extent that its limitations are adequately realized.

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STATISTICAL NEWS AND NOTES

Central Statistical Board

In order to forestall the independent submission of a large number of uncoordinated projects relating to the Census, the Central Statistical Board on March 14 created an interdepartmental committee to prepare recommendations on a WPA project based on Census material. As a first step, the committee is obtaining suggestions regarding tabulations of earlier Census data and computations based on present or past Census data which are needed for research and administrative purposes but which are not a part of the regular Census work and cannot be made by the Census Bureau. Special consideration will be given to small studies which it would not be feasible to set up as independent WPA projects.

The committee will examine each proposal from the standpoint of the value of results, the availability of the basic Census data to be used, and the suitability of the proposals to WPA requirements. It will endeavor to coordinate them into a single large project which can be carried on with maximum efficiency.

Members of the committee are: P. K. Whelpton (Central Statistical Board), Chairman; Calvert L. Dedrick (Bureau of the Census); E. Dana Durand (U. S. Tariff Commission); Howard B. Myers (Work Projects Administration); and Paul Webbink (Social Science Research Council). John J. Corcoran, Jr. of the staff of the Board is serving as secretary of the committee.

The Central Statistical Board has issued a fourth edition of the *Directory of Federal Statistical Agencies*. A limited number of copies are available upon request.

Central Statistical Board to Become Division of Statistical Standards, Bureau of the Budget

Statutory authorities of the Central Statistical Board expire on July 25, 1940. The Board was created by Executive Order in June 1933 and established for an experimental five-year period by Act of Congress on July 25, 1935. The terms of Reorganization Order No. 1 transferred the Board to the Bureau of the Budget and the Bureau of the Budget to the Executive Office of the President. After the expiration of the present statutory powers, the work of statistical coordination will be carried on within the Bureau of the Budget by a division to be known as the Division of Statistical Standards. A draft report covering the activities of the Central Statistical Board during the fiscal year 1939 has been prepared. While it is not planned to print the report, a few copies of the draft as submitted to the Director of the Budget will be mimeographed and persons interested will receive copies upon request.

Bureau of Foreign and Domestic Commerce

Since the first of the year a number of organizational and functional changes have been made in the Bureau of Foreign and Domestic Commerce —all designed to increase the usefulness of its work.

For many years the Bureau has been primarily concerned with the promotion of foreign trade and has developed many important and valuable services in that field. Conditions during more recent years have demanded greater attention to domestic questions. The changes which have been and are being made should enable the Bureau to function more effectively on this broader front without sacrificing any essential service to business in its foreign trade promotional activities.

Basic Problems Service. Divisions concerned exclusively with economic and statistical work have been grouped together and placed under the direction of Ernest A. Tupper, Chief Statistician of the Bureau. These consist of the Division of Buiness Review, the National Income Division, the Division of Foreign Trade Statistics, the Marketing Research Division, the Construction and Real Property Division, and the Special Research and Analysis Section.

The Division of Business Review will continue to have responsibility for preparing and editing the *Survey of Current Business.* It will develop significant series showing changes in manufacturers' sales, orders and inventories (already in the process of being firmly established). In addition, this Division will undertake intensive analysis of business conditions and business prospects.

The National Income Division will carry forward its work of estimating national income by sources and of income paid out by type of payment. It will continue the preparation of State breakdowns of income payments. It will shortly take over and carry forward the work of the National Bureau of Economic Research in the field of capital formation and final product analysis. This Division will also undertake to make comprehensive estimates of the volume of public and private debt. It is hoped that work in the field of distribution of income by income classes among families and individuals can be initiated in the not too distant future.

Several important changes are being made in the character of the work conducted by the Division of Marketing Research. A considerable part of the resources of this Division has been devoted in the past to the study of specific marketing problems of individual industries. In the future marketing studies which are primarily of significance to a single industry will be handled by the appropriate industrial division of the Bureau with the advice and guidance of the technicians in the Division of Marketing Research. The work of the Marketing Research Division will tend more in the direction (1) developing from existing governmental and non-governmental sources basic data which may be used to measure market potentials, (2) developing from case studies a body of information regarding the relative merits of the several practices employed in handling various phases of the

different marketing functions, and (3) encouraging, stimulating and developing studies designed to improve relations between producers and consumers.

The Division of Foreign Trade Statistics will continue to compile and prepare for publication the statistics of United States foreign trade. Special effort will be made to follow current trade movements more intensively in order that significant changes can be more quickly detected and brought to the attention of the government and the public.

The Construction and Real Property Section will continue to prepare its estimates of construction activity, and will supplement its present annual estimates with quarterly or monthly figures. The Section will also continue its studies of the major influences which operate upon the volume of various types of construction outlays. More emphasis will be placed upon the development of adequate information concerning the market for residential construction in individual cities, and the present activities of the Section in the collection of locally-compiled data on residential vacancies will consequently be expanded.

The Special Research and Analysis Section has been recently established in order to have a flexible group of people, free from routine responsibilities, available for research on exceptional, emergency and non-recurring problems. This unit will be concerned chiefly with research leading toward the modification and removal of practices which tend to retard business and toward the acceptance of practices which should tend to improve business, increase employment, and add to the national income.

Industrial Service. The industrial divisions of the Bureau have been placed under the direction of Carroll L. Wilson, Executive Assistant to the Director. They will continue their essential services in behalf of the country's foreign trade. In the domestic field, they will extend their current analyses of the flow of trade in their commodities. The information thus developed should assist business men in reaching sounder individual day-to-day decisions and thus in achieving greater stability in their operations. These analyses will include consideration of conditions in individual industries in relation to those in business as a whole, as well as the types of operating policies in the several industries which appear to be most effective in dealing with specific current situations.

The industrial divisions will encourage and assist trade associations in the development of a more detailed reporting of current trade statistics, in order to furnish a better up-to-the-minute basis for individual business judgments. This is a field in which business can best serve its own needs, with the inspiration and counsel of the Bureau staff. The Commodity Reporting Program, by which name this promotional effort is known, is a coordinated long-term project of the Bureau, in cooperation with the Bureau of the Census and other government agencies.

Another field of activity of the industrial divisions lies in analyses of the markets for their products and the study of opportunities for normal expansion and stabilizing diversification in individual industries. This will

include the study of specific industrial and consumer products in relation to consumer and national income and the pattern of consumer or industrial expenditure for those products.

International Service. The several technical divisions of the Bureau whose principal activities relate to the economic situation in foreign countries, now constitute a distinct group under the direction of Grosvenor M. Jones, Assistant Director. These divisions are Regional Information, Finance, Foreign Tariffs, Commercial Laws, Trade Agreements Unit, and Foreign Service Liaison.

By placing all of these divisions in one group, it will be possible to function more effectively, and to handle in a more comprehensive manner international economic problems that involve several of these divisions. Since the outbreak of the present war in Europe many of these problems have become so complex and their various phases are so interrelated that each such problem must, in the last analysis, be viewed as a whole. Moreover, these problems must be studied from the standpoint not only of their immediate effects, but also of their probable bearing upon conditions prevailing at the close of this war.

The Commercial Information Service. The Commercial Information Service has been established under Bruce Berckmans, Assistant Director, to coordinate the general reference and inquiry work of the Bureau and to improve the quality of distribution of the Bureau's services to business. In this work the Commercial Information Service, comprising the Commercial Intelligence, Editorial, and Correspondence Divisions, has been set up solely for the purpose of implementing the dissemination of the work produced by what might be called the "creative divisions." It is intended that the Commercial Information Service will in no way overlap or duplicate the services performed by the Industrial, International, or Basic Problems Divisions, but will relieve these Divisions to considerable extent of purely routine publication and inquiry activities. Centralizing these activities should not only expedite the dissemination of information but should actually, through operating economies, make available considerable funds for more constructive purposes.

Field Service. The Field Service of the Bureau, also under Mr. Berckmans, comprising thirty-five District and Cooperative Offices located in the principal business centers of the country, is likewise a service organization. It implements the distribution of the Bureau's services to business by making available at convenient points throughout the country the results of the creative divisions of the Bureau. It is intended to strengthen these activities by converting District Offices located in Federal Reserve centers into Regional Offices so that the Field Service will be in the position not only to disseminate services from the Bureau to business, but also to enable the Bureau to obtain at first hand reliable reports regarding the business conditions and business interests of various regions or geographical areas at any given time. Moreover, as the services of the Bureau in the field of domestic commerce are improved and broadened, these will be implemented by the

Field Service in much the same manner as their long recognized activities in the field of foreign commerce in the past.

Monthly Industry Survey. A monthly survey has been initiated by the Division of Business Review to meet the need of business men, economists, and statisticians for current and comprehensive data measuring the month to month fluctuations in the value of manufacturers' inventories, new and unfilled orders, and shipments.

The study was undertaken to fill certain important statistical gaps in existing current business information. There have been available in the past no general data covering the value of inventories for manufacturing as a whole or its major segments on a monthly basis nor have comprehensive current figures on the value of orders and shipments been compiled.

Since inventory fluctuations are of considerable significance in business movements and the bulk of such changes occur in manufacturing industries, it was considered important to secure such data on a monthly basis. Similarly, it was thought that the inter-relationship between the four series covered in the survey would throw light on some of the important factors underlying current changes in business activity. For example, the relationship of incoming business to shipments, when considered in connection with the inventory trend at the time would indicate the extent to which production was being maintained by backlogs of unfilled orders and by inventory expansion. Likewise data showing the magnitude of unfilled orders provides some indication of the support which production may receive from previously accumulated orders.

The magnitude and rapidity of inventory fluctuations in manufacturing as revealed by the data thus far compiled are worth noting. Between the end of June 1939 and the end of February 1940 manufacturers' inventory holdings were built up on a value basis by over $1,200,000,000. During the last quarter of 1939 the rate of accumulation amounted to about $300,000,000 per month. This was undoubtedly a major factor in the rapid rise in industrial production which occurred in the latter part of 1939 and which carried the production index to a record high in December.

The first schedules in the new Survey were distributed for the month of November 1939. The response to this canvass, conducted entirely on a voluntary basis, was extremely satisfactory and evidenced widespread interest in this type of statistical data on the part of business concerns. At the present time, the sample includes companies which account for more than one-third of total manufacturing activity in the United States. The inventory holdings of the cooperating companies amounted to more than $4,000,000,000 at the end of February 1940. February shipments of these companies amounted to about $1,500,000,000.

The size and composition of the sample are now considered adequate, with proper weighting, to provide a reliable measure of the monthly movements in the items covered for manufacturing as a whole and for a large proportion of the major industry groups. However, the sample coverage by industry varies considerably and in certain instances the data are not as yet

sufficiently representative to justify publication of separate figures. Efforts are being directed toward elimination of such deficiencies and it is expected that the amount of detail contained in the published reports will be expanded in future months.

The first summary report released for general distribution covered the month of December 1939. Reports have been issued on a monthly basis since that time and may be secured from the Bureau of Foreign and Domestic Commerce.

Annual Retail Credit Survey. The study this year will be similar to the previous reports with one principal exception. This year a special analysis will be made of selected balance sheet data which have been included in the schedule for the first time. This new material takes the place in the report of last year's analysis of credit and installment terms. Effort has been made in each of the recent annual reports to improve the sample. Last year the sample was increased 45 per cent with a total of 2500 reporters; this year the sample has been increased to 4000 reporters, a gain of about 60 per cent. The report will carry the usual analysis and statistics dealing with cash and credit sales, collection ratios, and bad debt losses.

The Annual Bad Debt Loss Survey. This survey was initiated last year with the cooperation of the National Association of Credit Men. The first report was published by *Credit and Financial Management.* This year the report will be published in the July issue of the *Survey of Current Business* and reprints will be available for general distribution. The report will present an analysis of both gross and net bad debt losses of wholesalers and manufacturers. The new study will also contain a further analysis of bad debt losses for the respective years, according to the age of the accounts written off. Data have also been secured for the first time to show characteristic terms offered by both wholesalers and manufacturers. These new data will permit an examination of the relations between bad debt losses and credit terms. The report, as usual, will show an analysis by kind of business, size of establishment, and regional location.

Consumer Installment Credit Reports. As the first step in a new program being developed by the Credit Analysis Unit of the Marketing Research Division the first release of a series dealing with consumer installment credit has been issued. This initial release presents monthly data on outstandings and consumer loan volume of industrial banking companies from 1929 through 1939. Similar statistics are to be developed on a monthly basis for other principal types of agencies lending to consumers on an installment repayment basis. Personal loan departments of commercial banks, personal finance companies, and credit unions are the agencies from which the Bureau plans to secure data comparable to the industrial banking figures. When this work for cash lending agencies has been established, the Bureau will undertake the preparation of current material on the installment volume of retail establishments. The retail reports will supplement the data which the Bureau now presents annually in the *Retail Credit Survey.*

The data which will be presented in this series are a continuation of ma-

terial on consumer installment credit volume developed on a monthly basis from 1929 through 1938 by the National Bureau of Economic Research. As a cooperative project with the Department of Commerce and the Russell Sage Foundation, the National Bureau of Economic Research has prepared separate series on credit volume and related factors for the principal cash lending agencies and the major retail trades featuring deferred payment sales. All of these series will be brought up to date and continued currently by the Department of Commerce.

National Income Studies. Released in the April 1940 issue of the *Survey of Current Business* were estimates of income payments to individuals, by states, for the years 1929 through 1938, prepared by the National Income Division. This Division has also made progress with revisions of estimates of national income for the years 1929 through 1938 and their extension for 1939. These figures will be released in the June 1940 issue of the *Survey* and a bulletin reporting data in more detail and incorporating some analysis and brief explanations of sources and methods will be issued during the summer. A survey of gross and net debt in the United States for the years 1929 through 1939 is being completed and will be released in the June 1940 issue of the *Survey*, to be followed by a bulletin on this subject. A bulletin on monthly income payments in the United States, 1929–1940, has gone to press. Some exploratory work has been accomplished in the field of final product analysis.

Concentration Studies. The Special Research and Analysis Section continued the preparation of the three studies it has been making for the Temporary National Economic Committee. The first study, entitled "The Integration of Manufacturing Operations," is concerned with the analysis of the extent and significance of central-office operations, as measured by the number of establishments, wage earners, value of product, etc. The functional relations of establishments within central offices are classified and analyzed.

In the second study, "The Concentration of Production in Manufacturing," 1807 census products have been analyzed and the concentration in the manufacture of these products has been measured in terms of the proportion of the total value of each product accounted for by the four largest producers. The products have been selected to give a cross-section picture of product concentration as it existed in 1937, and are being studied to determine the factors with which concentration is associated.

The third project relates to "The Product Structures of Large Corporations." Production statistics for the fifty largest manufacturing corporations (selected on the basis of their value of product) have been analyzed to determine the number of products manufactured, the proportion of total United States value of each product accounted for by each company and the contribution of each product to the companies' total value of products. In addition the significance of these fifty companies in relation to all manufacturing has been evaluated.

Export Statistics. In view of the increased interest in following the trend of

United States exports since the outbreak of the war in Europe, the Division of Foreign Trade Statistics has arranged to release a preliminary statement each month, about ten days prior to the release of final monthly figures. It should be borne in mind that the figures issued about the sixteenth of each month are preliminary and subject to revision.

E. A. TUPPER

Board of Governors of the Federal Reserve System

An article, "Investments and Liquidity of Member Banks in 1939," by Victor M. Longstreet, appears in the April 1940 *Federal Reserve Bulletin.* This article discusses the changes during 1939 in holdings of investments of various types and maturities at different classes of member banks, changes in amounts of United States Government obligations outstanding and held by Federal Reserve banks and member banks, and changes in the average liquidity position of the different classes of member banks by Federal Reserve districts.

The "Trend of Member Bank Earnings and Profits" is analyzed in an article by Roland I. Robinson, appearing in the May *Federal Reserve Bulletin.* The article is based on the earnings and dividends figures reported semi-annually by member banks. In addition to a review of current economic factors which influence bank earnings—lower interest rates mainly—some of the differences in earnings and profits among banks located in various parts of the country are examined.

Estimates of the distribution of demand deposit holdings by economic classes of depositors as of December 31, 1937, were presented in an article by Haskell Wald which appeared in the May 1940 issue of the *Federal Reserve Bulletin.* These estimates are based upon data compiled primarily from corporation income tax returns and represent a continuation of the study on the distribution of demand deposits published in the *Federal Reserve Bulletin* for October 1939 and of the earlier study by Martin Krost and Lauchlin Currie which appeared in this JOURNAL for June 1938. This most recent article reviews changes in the demand deposit holdings of the various classes of depositors between the end of 1933 and the end of 1937, and also presents estimates of the distribution of time deposit holdings.

Division of Tax Research, United States Treasury Department

The Division of Tax Research of the Treasury Department has, since January 1940, published two studies in the *Bulletin of the Treasury Department.*

The February 1940 issue contained an analysis of types of dividends paid by corporations in 1936 and 1937 as compiled from corporation income and excess-profits tax returns for those years.

The April 1940 issue presented a study of the provisions relating to consolidated returns for income and profits tax purposes under the Revenue Acts of 1913–1939.

A table prepared by the Division of Tax Research, showing the individual income tax liability and effective rate of tax in the United States, Great Britain and Germany 1940 at selected income levels for single persons with no dependents and married couples with two children, appeared in the Internal Revenue News Letter for March 15, 1940.

United States Tariff Commission

In the first quarter of the current year, the Tariff Commission has issued a number of reports on various aspects of the trade agreements program. The more important of these are as follows:

1. Effect of trade agreements on rates of duty
2. Pre-agreement and post-agreement trade of the United States with the principal countries with which trade agreements were made before 1937
3. Important import items affected by trade agreements
4. United States imports and trade agreement concessions
5. Reciprocal trade agreements and various industries

The first report in the list shows the effect of the reduced rates of duty not only on total imports but on imports under each of the tariff schedules. It discloses that the highest percentages of rate reductions have been made in Schedule 8, *Spirits, Wines and Other Beverages*, while the lowest reductions are in Schedule 11, *Wool and Manufactures of*, and Schedule 2, *Earths, Earthenware, and Glassware*.

The fourth report on the list appears in 8 volumes and gives tariff, statistical, and trade data with respect to each of the 1200 items on which the United States has granted concessions under the Trade Agreements Act. The last report listed is issued as a series and will eventually cover about 60 industries. The 7 reports in this series issued to date apply to the following industries: Tobacco, Sugar, Fats and Oils, Glass, Lace, Pottery, and Dairy Products.

Commodity Exchange Administration

The Commodity Exchange Administration started with March 1940 the issuance of a monthly mimeographed publication entitled "Trade in Cotton Futures." This publication gives statistical information on volume of trading, open contracts, and prices for cotton futures at New York and New Orleans. It corresponds for cotton to the publication entitled "Trade in Grain Futures" which has been issued for many years.

Bureau of Labor Statistics, U. S. Department of Labor

Prices and cost of living. Using a modified list of commodities and weights as determined by the 1934–36 family expenditures study, the quarterly cost of living index has been revised back to 1935. The monthly food cost index, which enters into the general cost of living figures, has been similarly revised. The indexes are now presented on a new base period, the average of the five years 1935–39. A description of the revision is to be presented in the July issue of the *Monthly Labor Review*.

In cooperation with the WPA, a project has been undertaken to test the effectiveness of the median to represent average retail prices, as compared with the arithmetic mean now used. If the median is found to serve the purpose, it may be possible to publish the monthly average prices and indexes more promptly.

An experimental price collection is being made for a limited number of items in six cities in stores patronized primarily by negroes and Mexicans to determine whether significant differences in prices exist between these outlets and those covered in the Bureau's regular quarterly collection for cost of living data. The experimental pricing is being done as of March and June 1940. Stores patronized by races other than white will be added to the Bureau's list of outlets if significant differences are found.

A history of the Bureau's rent indexes is being prepared. This report will include data on rents from surveys of family expenditures from 1889 to the present. It will contain a description of methods used in securing information and constructing rent indexes with special emphasis on the revision of the Bureau's rent samples in 1937 and 1938. It will also include some details of rent changes not previously published by the Bureau.

Indexes of rents for Manchester, N. H., have been issued for the first time. The indexes are for dwellings of different types and are for quarterly periods from March 1935 to date.

A series of individual city reports is being issued on prices of bituminous coal, from 1935 to date, the data having been reclassified by kind and size of coal. The 51 cities covered in the current reports are included.

In consultation with manufacturers' representatives, the specifications of rug and carpet items priced at wholesale by the Bureau have been revised to represent current volume sellers and prevailing marketing practices. A mimeographed statement regarding the revision is available upon request.

Labor turn-over. Since January 1940, labor turn-over rates have been published for 29 states in addition to the rates for 33 industries and the combined rate for 144 industries and all states. The 29 states are those in which the reporting sample is considered sufficiently representative to warrant the publication of separate figures.

Wages and hours. A study of wages, hours, and working conditions of firemen and policemen has been completed. The study covered all cities of 25,000 population or over, and was made as a WPA project. Separate reports will be issued for each of the nine geographic divisions for policemen and firemen. The first report, on firemen in New England cities, is now available for distribution.

Work has been begun on four new surveys of wages and hours. They will be concerned with (1) coastwise longshoremen and related occupations in six southern ports, (2) jewelry, (3) the drug industry, and (4) hosiery, a special survey of nine plants in the South.

Construction. For several years the Bureau has been issuing quarterly estimates of the number of dwelling units provided and the value of new residential building in the urban areas of the United States. Beginning with the

first quarter of 1940, the estimates include the entire non-farm area of the country; the area added covers all places with a population under 2500 not on farms. An analysis is being made of the basis for determining building permit fees in various cities, i.e., whether the fee charged is based on the total value of the building, square feet of floor space, cubic feet of content, etc.

Industrial injuries. The annual survey of industrial injuries in the United States is being completed covering the year 1939. The sample of about 35,000 firms is approximately 10,000 larger than for the 1938 survey, having been augmented by a cooperative arrangement with the Pennsylvania Department of Labor and Industry. The State Bureau of Inspection, in connection with its annual safety contest, sent employers the injury reporting schedule and the returns were utilized by the Bureau of Labor Statistics. Two special analyses are being made on (1) the relation of industrial injuries to age, on the basis of data collected by the Wisconsin Industrial Commission during the years 1919 to 1938, and (2) the relation of industrial injuries to hours worked and fatigue, utilizing data from the Pennsylvania Department of Labor and Industry for the year 1938.

Children's Bureau, U. S. Department of Labor

At the request of the Bureau of the Census, the Children's Bureau is preparing suggested plans for tabulations that may be made by the States of the information to be obtained from the medical items of the standard stillbirth certificate and the optional section of the standard live birth certificate (1940 revision). The plans will include editing and coding instructions, positional assignments for punch cards, and basic drafts of tables giving specifications for machine tabulations.

Thirty-three States have adopted all or part of the medical items recommended for live births and 21 have adopted the standard certificate for stillbirths. Additional States have reported that they expect to include the medical items in their certificate forms. The States that tabulate the information in accordance with the plan being developed will make available a new body of statistical fact with respect to conditions underlying pregnancy and childbirth. The information will be used by State maternal and child-health divisions, crippled children's division, and nursing services, by the United States Children's Bureau, and by other national and local agencies in planning new programs and improving the quality of programs already under way in the various sections of the country.

The Current Reports Section of the Division of Statistical Research has begun the issuance of monthly releases in a number of statistical series designed to indicate trends in the volume of service provided in 20 individual health and welfare fields. These monthly releases apply only to urban areas and are based on reports submitted for cities cooperating in the Registration of Social Statistics. The respective series reveal trends in the number of children receiving care away from home, the total attendance at certain organ-

ized leisure-time activities, the number of visits by public health nurses, the number of patient days of hospital care provided, and so forth. Copies of these releases may be secured on request from the Division of Statistical Research.

Women's Bureau, U. S. Department of Labor

The Women's Bureau has completed surveys of employment conditions in the citrus-fruit-packing industry and establishments packing fresh apples, tomatoes, lettuce, celery, and miscellaneous vegetables when not situated on farms. The citrus-fruit-packing report is available on request; the other reports may be consulted at the Bureau.

Also completed is the study of wages and hours in the service and trade industries of Maine, comprising stores, hotels and restaurants, laundries and cleaning plants, and beauty shops. Effects of the tourist trade are indicated by the fluctuation in employment, greatly increased numbers being employed for a few weeks of the year; in fact, 40 per cent of the women in laundries and cleaning plants, 48 per cent of those in beauty shops, and more than 60 per cent of those in hotels and restaurants, though "seasonal hotels" were not scheduled, had employment for six months or less in 1939.

Bureau of Research and Statistics, Social Security Board

The Division of Public Assistance Research has been requested by the American Public Welfare Association to collect data on administrative expense from the 19 large cities participating in the intercity exchange of current data on general relief. In response to an inquiry from the American Public Welfare Association, 14 cities have already indicated their desire to participate in this cooperative enterprise. The first report will cover the 6-month period ending June 30, 1940.

The Division of Public Assistance Research is now preparing a tabular summary which will present State data for the three special types of public assistance for each month of the period January 1936 through December 1939 and for general relief, from April 1937 through December 1939. County detail will be presented for December 1939.

Data for each State on total expenditures for payments to recipients under the various public assistance and Federal work programs and on amounts per inhabitant for the calendar years 1938 and 1939 appear in the March issue of the *Social Security Bulletin*. Data on total expenditures and amounts per inhabitant for the 116 urban areas for the calendar year 1939 will be published in the *Social Security Bulletin* for April.

Plans are completed for revision of the project for collecting data on the social characteristics of recipients of old-age assistance, aid to dependent children, and aid to the blind, effective with the fiscal year 1940–41. The social data have now been collected for three fiscal periods and will be collected for the current fiscal year. These data have been and will continue to be of great value for purposes of planning. It now appears desirable, however,

to simplify the project substantially, as analysis indicates that the data on cases accepted and closed are less adequate for determining the social characteristics of recipients for programs which are fairly well established than for programs in the earlier stages of development. Under the simplified plan, certain basic information such as previous relief history, reasons for closing cases, and reasons for dependency in aid to dependent children cases will be collected. In addition to the annual report based upon these items, tabulations will be required of direct money payments to all recipients of the three special types of public assistance, classified by size of payment, and for aid to dependent children, also by number of dependent children in the household.

Analyses made by the Division of Health Studies of the entire urban sample of family composition in the United States have yielded information on the employment status of workers in the family in relation to employment status of the family head and to family size, and data on the family structure and income of urban families with disabled heads. These findings will appear shortly in the *Social Security Bulletin*.

The research program of the Division of Economic Studies has recently been expanded to include a new project in the field of its general work on the economic effects of social security. This study will deal with interrelationships of tax yields and benefit disbursements over a period of years under old-age and survivors insurance and will consider the effects on purchasing power occasioned by the operations of the old-age, employment, and public assistance programs, especially as they affect the flow of money values and goods.

In connection with its studies of fiscal capacity of the States, the Division of Economic Studies has for some time been assembling basic data on income trends, geography and population, revenues and revenue requirements, and similar material for individual States. The purpose of these studies of individual States is simply to bring together and point up available statistics indicating basic economic and fiscal trends. Periodic revision of the compilations is necessary in order to include new material as it becomes available. Substantial revision of material for Pennsylvania has recently been completed.

Research and Statistics Division, Bureau of Employment Security, Social Security Board

The initial processes involved in the taking of a nation-wide inventory of the active files of job-seekers registered at public employment offices were completed during the last week of March and the first two weeks of April. The Research and Statistics Division arranged that the inventory should be taken through the facilities of the research and statistics units of State employment security agencies. The inventory will provide information on the personal, industrial, and occupational characteristics of registrants in local employment offices as of the same period for which the 1940 census was

taken. The data are now being tabulated in the States preliminary to the preparation by this Division of national summarizations. In addition to data on occupation, industry, sex, age, color, and veteran status, which will be available from all States, arrangements have been made for detailed tabulations in certain metropolitan areas within a selected number of States. It is hoped that the inventory will make possible a comparison of some of the socio-economic characteristics of workers in the active files, with the unemployed enumerated in the census. The coding of "industry" of workers in the active files will be made on the basis of the *Social Security Board Industrial Classification Code.*

A monograph on employment and pay rolls in State unemployment compensation systems in 1938 was completed in April and copies were made available for public distribution. The monograph, which will be issued in two parts, consists of an introductory text indicating the character of data reported and how the information may be used. The text is accompanied by a series of charts showing monthly employment in 1938, by States and industrial divisions. The second part of the monograph consists of approximately 150 tables presenting monthly employment data and quarterly pay-roll data classified by the major industry groups of the *Social Security Board Industrial Classification Code.*

An article on the effect of using annual earnings as a basis for determining weekly benefit amounts was prepared for the May issue of the *Social Security Bulletin.* The statistical data presented in this article are based upon special studies conducted in a number of States as well as on the actual benefit experience of four States which have adopted in their laws annual-earnings plans for determining weekly benefits. The analysis of these data indicates that annual-earnings plans result in a lowering of the amount of benefits paid for weeks of total unemployment and may give rise to inequities in benefit payments to workers whose weekly earnings are approximately the same. As a part of the studies of benefit experience in the various States, actuarial analyses of the solvency of State unemployment compensation funds are now being reviewed. A number of States have been requested to prepare tabulations on the duration of benefits in advance of the due dates for such tabulations specified in the Social Security Board statistical reporting program. This basic information will make possible more adequate analyses of benefit experience and will at the same time provide some guidance in the consideration of modifications of present benefit formulas.

The final drafts of part 4 (the alphabetic index of products, establishments, and services, by major industrial groups) of volumes I and II of the 1939 issue of the *Social Security Board Industrial Classification Code* were completed. This material is now being reproduced and will be issued shortly.

The Division, in cooperation with staff members of the Division of Placement and Unemployment Insurance of the New York State Department of Labor, is conducting an economic survey of the New York City labor market. This survey will include analyses of the characteristics of unemployed workers registered at public employment offices in New York City and the

utilization of such offices by employers in filling job openings. It is expected that the survey will furnish a basis for a better understanding of how the public employment service may more effectively contribute to the organization of local labor markets.

A monograph on *Current Experience-Rating Research* was recently completed. Copies were forwarded to all State employment security agencies. The material contained in this monograph indicates the developments which have taken place with respect to experience-rating procedures and studies. In addition to presenting data on the results of experience-rating operations and studies in several States, the monograph also contains summary provisions of State laws regarding experience rating and a bibliography of published materials relating to this field.

Bureau of Old-Age and Survivors Insurance, Social Security Board

A survey of the statistical program of the Bureau of Old-Age and Survivors Insurance has been completed by the Central Statistical Board. In addition to recommendations for certain technical improvements in the tabulations, the report suggested additional tabulations designed to supplement the data on employment and pay rolls collected by the Census for 1939. Emphasis was placed upon the desirability of securing reports from employers on an establishment basis so as to be able to make more complete and accurate tabulations of employment and earnings by industry. The report outlined a program of economic analysis of the employment and earnings data and plans are under way by the Bureau to undertake these studies.

Final tabulations showing number of 1938 employees, their 1938 wages, their cumulative wages and the number of quarters within the year during which they were employed, by age, sex and race, State of employment, industry, and wage intervals, have been made for all States. Tables are now being compiled and will be ready for publication by the last of June. Persons interested in obtaining copies of these tables should address their requests to Mr. John J. Corson, Director, Bureau of Old-Age and Survivors Insurance, Social Security Board, Washington, D. C.

Fifty of the fifty-four reporting jurisdictions (46 States, Alaska, Hawaii, and the separate registration cities of Baltimore and New Orleans) have now agreed to cooperate with the Social Security Board on its plan to obtain a copy of a short form death certificate for all holders of social security account numbers and beneficiaries. Special agents have been appointed in all the cooperating jurisdictions, except Ohio and Virginia, and it is believed that the inauguration of the plan will be accomplished in these places in the near future. Proofs are already being received from 43 States, Alaska, and the cities of Baltimore and New Orleans.

A change in the mechanical operations setup for posting wages necessitates in 1939 tabulation of employee data being made on a sample basis. Thus far, reported wages have been posted to the individual accounts once a year. In order to spread the posting operations over the whole year, a plan

for posting, referred to as "cyclical," has been accepted. This plan provides that the account numbers shall be divided into four segments, the wages for a twelve-month period to be posted at three months intervals for each segment. The twelve months periods are to be as follows:

January through December—posted June, July, August
April through March—posted September, November
July through June—posted December, January, February
October through September—posted March, April, May

It is planned that the tabulation of the statistical sample of 1939 employees be drawn from that segment from which calendar year postings are to be made. Mr. Frederick F. Stephan, Secretary of the American Statistical Association, Miss Aryness Joy, Bureau of Labor Statistics, and Mr. John N. Webb, WPA, are serving as a committee to investigate the problems involved and advise as to the best method of picking an adequate sample.

U. S. Office of Education

The survey of the content and availability of cumulative pupil-record cards, being conducted for the information of various government offices, has progressed to the tabulation stage. A reference file is to be established to show what data are requested and what school systems are keeping these cards and tabulations will be made to show current practices.

Division of Research, Work Projects Administration

A re-survey of workers separated from WPA employment in accordance with the 18-months provision of the 1939 Relief Act showed that by February first 54 per cent of the workers dropped in July and August 1939 for this reason had been reassigned to WPA. A considerably larger proportion had been recertified. Those not reassigned by February first were interviewed to find out how many were employed in private industry, how many were receiving direct relief, and what their sources of income were.

Sample studies were made in the same 23 cities in order to determine how many of the workers who left WPA voluntarily during September and October left to accept private employment. Information from this study will also throw light upon the types of jobs obtained by workers who leave WPA of their own accord.

Division of Statistics, Work Projects Administration

A preliminary summary of the major items of accomplishment on WPA projects from the beginning of the program through December 31, 1939, has been completed. This tabulation covers all fields of WPA activity and for most items, the entire period. For those items not adapted to this type of treatment, the data represents accomplishment during specific recent periods of two weeks or a month in length. State and county summaries are now available in the WPA State offices.

Graduate School of the Department of Agriculture

The Graduate School of the Department of Agriculture plans the addition of several new courses in statistics for the fall of 1940. J. Stevens Stock and Lester Frankel will jointly give a course in "Sampling Methods in Social and Economic Data." Dr. Solomon Kullback of the War Department will offer "Theory of the Characteristic Functions." A course in "International Statistics" will be offered by Dr. J. C. Rocca. Dr. W. G. Madow will teach two courses, one entitled "Intermediate Statistics" and another, "Statistical Methods for Research Workers." Dr. C. Winston will teach "Theory of Functions."

Revisions in California Labor Statistics Bulletin

A number of changes have been made in the *California Labor Statistics Bulletin* (formerly the *California Labor Market Bulletin*) starting with the issue containing the July 1939 statistics of employment, pay rolls, hours, and earnings. These changes include a regrouping of the industries to exclude non-manufacturing from the manufacturing industries, and the addition of tables showing month-to-month changes in employment, pay rolls, hours, and earnings.

Previously, several non-manufacturing industries had been included among the manufacturing industries, and the item which for many years was designated as "All Industries" and later as "All Industries excluding Public Utilities and Trade" was an aggregate of manufacturing industries and some non-manufacturing industries, including crude petroleum producing, motion picture producing and developing, laundering, cleaning and dyeing. This aggregate had been used and quoted as a total of "manufacturing" industries.

Because of the inclusion of these non-manufacturing industries, the changes shown in the totals previously obtained were not necessarily representative of changes in manufacturing employment and pay rolls in California. Nor were such figures strictly comparable with the totals for manufacturing industries compiled by the Bureau of Labor Statistics for the nation as a whole and with similar statistics published by individual states.

A more serious difficulty extended to the statistics of average weekly and hourly earnings, and average hours per week contained in the *Bulletin*. Not only was there a lack of comparability with the corresponding averages for the United States as a whole, and with those of other states, but the averages were subject to considerable distortion.

By including crude oil producing and motion picture producing (two industries where wage rates and earnings are very high) in the total for all manufacturing industries, an average hourly earnings figure for Los Angeles County was obtained each month which was as high, or higher, than the corresponding average for San Francisco County, where there is no crude oil producing or motion picture producing. This appeared unreasonable in view of the well-known fact that wage rates in Los Angeles were generally lower

than in San Francisco. The Division received numerous communications questioning these averages.

In the combined total for the State as a whole, the inclusion of crude oil producing and motion picture producing among the manufacturing industries tended to pull the weekly and hourly earnings figures above the average for the industries definitely classified as manufacturing.

Changes Made. The industries listed in the *California Labor Statistics Bulletin* were reclassified as to manufacturing and non-manufacturing on the basis of the U. S. Bureau of Labor Statistics and U. S. Census Bureau classifications. The non-manufacturing industries heretofore carried among the manufacturing industries were separated from the manufacturing industries and shown among the nonmanufacturing industries. This affected crude petroleum producing, motion picture producing and developing, laundering, cleaning and dyeing, and steam railroad repair shops.

The data were carried back on the revised basis to January 1938 for the State as a whole, and to August 1938 for Los Angeles and San Francisco Counties, and published in tables accompanying a memorandum explaining the changes made, which was sent to those receiving the July 1939 *Bulletin.*

Other Revisions in the Bulletin. Formerly, the *California Labor Statistics Bulletin* emphasized the year-to-year changes. The tables for the State as a whole showed changes in employment and pay rolls from the same month a year ago for all industries and all industry groups. Changes from the preceding month, however, were shown for only a limited number of individual industries. Thus, it was extremely difficult, if not impossible, to trace month-to-month changes in employment and pay rolls for most of the individual industries. This was one of the outstanding weaknesses of the *Bulletin,* especially in view of the fact that the statistics of employment and pay rolls are not shown in the form of index numbers but in the form of percentage changes.

Starting with the July 1939 issue, the tables contained in the *Bulletin* have been expanded and revised to show month-to-month changes for every item for which a year-to-year change is shown. This has considerably increased the usefulness of the *Bulletin,* permitting the construction of index numbers for individual industries by the chain-base method.

Changes were made in the tables containing employment, pay rolls, hours, and earnings statistics for Los Angeles and San Francisco Counties. Totals for all industry groups are now shown for these two counties, as well as important individual industries within the industry groups. Also, several non-manufacturing industries are included in the county tables which heretofore were not shown. The catch-all n. e.c. classifications have been eliminated from the county tables.

Index Numbers. As already pointed out, the employment and pay roll statistics in the *California Labor Statistics Bulletin* are shown in the form of percentage changes from the same month a year ago and from the preceding month. Most users of the *Bulletin* find it difficult to secure a long-term picture of the trend in employment and pay rolls on the basis of these per-

centage changes. The maximum value of the employment and pay roll statistics is not realized because of the present form of these data.

Lack of funds has made it impossible to change the method of compiling the employment and pay roll statistics to the index number basis. The usefulness of the data would be greatly increased if they were in the form of index numbers. A study is now being made of the possibility of making the much needed change to the index number basis.

M. I. GERSHENSON
Division of Labor Statistics and Law Enforcement
California State Department of Industrial Relations

Dominion Bureau of Statistics, Canada

Municipal Finance Statistics. The second Dominion-Provincial Conference on uniform municipal statistics in Canada is scheduled to meet at Ottawa, May 6–7–8 next.

Continuing Committees, which were appointed at the previous Conference (held in July, 1937) for the purpose of studying the various problems connected with reporting financial activities of municipal governments throughout the Dominion completed their tasks last fall and a general Conference to consider their reports was planned to take place in December. The outbreak of war, however, necessitated postponement until the present.

The Conference will be attended by representatives similar to those appointed in the first Conference referred to in the December 1937 issue of this JOURNAL. Dr. R. H. Coats, Dominion Statistician, is the continuing Chairman of the Conference.

The reports of Committees to be considered deal with following subjects:

1. Terminology of Municipal Accounting
2. General Municipal Statistics
3. Revenues, Expenditures and Balance Sheets
4. Instructions to Municipal Officers for reporting statistics of revenues and expenditures
5. Classification of Local Government Units
6. Assessment and Population

With regard to the last mentioned subject it will cover the field of legislative enactments throughout the Dominion which define the various bases of assessment. It will also consider the definition of urban and rural populations along the lines adopted for Dominion Government Census purposes.

Manufacturing Statistics. A special report entitled "Weekly Earnings of Male and Female Wage-Earners Employed in the Manufacturing of Canada, 1934–36" is ready for publication.

In recent years there has been an increasing public demand for more detailed information regarding the distribution of the pay-rolls of the manufacturing industries of Canada among the individual wage-earners employed. The present publication includes the statistics compiled from a supplemental schedule sent out to all manufacturers reporting to the Census of

Manufactures in respect to their operations in 1934, 1935 and 1936, and endeavors to supply the information required.

The differences in the constitution of the wage-earning population of the two sexes, as shown by the Census of 1931, made it necessary for maximum usefulness that information should be obtained and compiled separately in respect of the wage-earners of each sex. As the result of this special study, it is now possible to compile statistics of weekly, as well as annual, earnings of male and female wage-earners separately.

Salaried workers, such as managers, superintendents, professional and office or clerical employees, whose remuneration is on the average larger than that of wage-earning employees, were not included in this study.

It is believed that the contents of this publication will be useful to administrators, social workers, and others interested in the welfare of the wage-earning population.

Shipping Statistics. Up until the present fiscal year statistics of shipping in and out of Canadian harbors have been compiled by Collectors of Customs at each harbor. Each collector summarized the data for his harbor and forwarded the summaries to Ottawa after the close of the fiscal year, to be combined into tables for Provinces and for the Dominion.

Commencing with April 1, 1940, vessels arriving and departing from a Canadian harbor make a report upon departure. The report shows the country of registry, net registered tonnage, rig, kind, and maximum draft loaded of the vessel. It also shows the date of arrival, draft upon arrival (fore or aft whichever is the greater) and class of service—

1. Foreign (between Canada and foreign countries)
2. Coasting with cargo (between Canadian ports)
3. Coasting in ballast (between Canadian ports)
4. Fishing (Canadian waters)
5. Fishing (Deep sea)
6. Other

Similar data are shown for departure.

For vessels in foreign service, data on cargo unloaded from foreign countries and on cargo loaded for foreign countries are shown. These data are: country in which cargo was taken for the port and country for which cargo was loaded at the port, kind of cargo, and tons weight and tons measurement. The kind of cargo is limited to bulk cargoes such as coal, lumber, grain, oil, etc., and general. Lastly, the last port cleared from and the first port cleared for are shown for arrival and departure respectively.

Vessels unloading no cargo upon arrival or taking on no cargo at the port of departure are considered in ballast irrespective of cargo on board for or from another port or passengers or mail unloaded or loaded. A vessel remaining in port for an extended period or a tow scow with no officer in charge makes a report upon arrival and another report upon departure with an appropriate notation explaining why both sides of the report are not completed. These reports are forwarded daily to the Dominion Bureau of Statistics at Ottawa by the Collector of Customs at each port as the reports

are filed after being numbered consecutively by the Collector.

For vessels with general cargoes for which it is not feasible to show the tons of cargo from each country or for each country, at time of departure, the vessel agents are allowed ten days after departure in which to forward the data to Ottawa.

For vessels in regular service between Canadian ports or between Canadian and United States ports, or tugs operating regularly out of Canadian ports, monthly reports may be filed instead of reports for each trip. These monthly reports are filed upon the last departure and will show the number of arrivals and the number of departures of the vessel in each class of service. If in foreign service (between Canada and the United States) the reports will show the details of cargoes unloaded and loaded.

By using the same net registered tonnage and nationality of vessels for both arrival and departure for practically all vessels, the chance of error is greatly reduced compared with the method used in previous years. Also, details of cargoes unloaded from and loaded for each country as distinct from country cleared from and for will make possible a much better analysis of foreign cargoes and movements of vessels.

Although the kind of cargo is limited to bulk cargoes these data will be much more informative than shipping statistics in previous years when only tonnages were available.

No data are being collected of cargoes of vessels in coasting service and consequently the only data available will be the number of vessels and net tonnages.

The draft data collected are for the information of the Federal authorities with jurisdiction over harbor work and for the present these will be compiled as and when required.

Fur Farming Statistics. Owing to the fact that mink raising has become of such importance as to be second only to silver fox farming, it has been decided to include in the annual statistical report a section covering separately this branch of the fur farming industry. The data will be given by counties and districts and will show the number of farms, the value of property, the number and value of live animals and of pelts sold, and the number and value of animals on the farms at the end of the year.

Construction Statistics. Commencing with January 1940, the report of "Building Permits Issued" includes permits issued by 202 municipalities, all the municipalities in Canada which require permits for building operations. The report also includes a classification by values, according to the types of construction, and it also separates new construction from additions, alterations and repairs. The former series of reports covered only 58 cities and showed only the total value of building permits issued, no distinction being made between new construction and improvements.

Education and Library Statistics. In conformity with the policy of making its reports of maximum usefulness, the Education Branch has been enlisting the assistance of librarians in revising its library questionnaires. The questionnaire for special libraries has been the subject of detailed study by the

Librarians' Group of the Professional Institute of the Civil Service of Canada, and a form has now been agreed upon for trial in the collection of 1939 statistics. In the absence of a Dominion library organization, the largest provincial library association, that of Ontario, is similarly undertaking to study and revise, in collaboration with the officials of the Education Branch, the questionnaire used for public libraries.

Survey of Family Living Expenditure. As a supplement to the Bureau's 1937–38 survey of urban wage-earner family living expenditures, records of living expenditures from 1,692 farm families have been collected for 1938. Although these were not obtained upon the same random basis as the urban records, they provide an approximate basis for comparing farm and urban family expenditures. The preliminary results of the farm survey are contained in the bulletin, "Canadian Farm Family Living Expenditures, 1938."

An examination of the nutritional aspects of urban wage-earner family food purchases will be released shortly as the seventh preliminary bulletin in the nutrition and family living expenditure series.

Demography. Volume I of the quinquennial Census of Saskatchewan has now been published. This volume is similar in scope to the Volume I of the Manitoba Census.

Dun & Bradstreet, Inc.

Retail Operating Cost Survey. After a three-year interim, typical retail operating costs and profits are being compiled again under the direction of Walter Mitchell, Jr. The present survey will be based on the 1939 operating statements received from over 15,000 concerns representing 60 or more lines of retail trade. Gross margin, inventory turnover, and detailed expenses will be included in the survey results—scheduled for publication in July or August. The ratios will be presented in such detail as may be significant—according to size of store, region, and type of business. Professor Theodore H. Brown, of the Harvard School of Business Administration, is acting as technical consultant.

Survey of Opinions about Accounting: Conventions and Policies. Under the direction of Roy A. Foulke, accountants, credit men, bankers, and corporation treasurers, representing a nation-wide sample, are being asked to predict the nature of the "Financial Statement of the Future." The questions deal with such problems as: desirable extent of description of assets, method of presenting consolidated statements, verification of inventories and receivables, accurate definitions of current liabilities, uniform practice in charges to surplus, wording of accountants' certificates on audits, responsibility of accountants to directors, stockholders, and public.

Studies of Big Business. An early issue of *Dun's Review* will carry the fifth in the series of articles by Mr. Edwin B. George on the size of business. This latest installment will discuss "why big business got big." What political, social and economic factors produced it? To what extent are its foundations logical and is there a stage of growth where logic becomes irrelevant? What are the problems in judging success and failure, and what should be the standard for such efforts?

Business Trend Survey. The final report, compiled under the direction of Walter Mitchell, Jr., was published in the May issue of *Dun's Review.* It shows the trends of sales and inventories, together with dollar estimates of 1939 sales and estimated inventory valuations at the beginning of 1940—separately for approximately 100 lines of business. These dollar estimates may serve as a "raft" to cling to until Census reports begin to be available later in the year. The estimates are based on returns from a nation-wide mailing of questionnaires and carry forward a series of annual estimates dating from 1935.

Study of New Businesses. A detailed study of a sample of new business enterprises is being planned with a view to determining the sources of the capital used, the age and previous experience of the entrepreneurs and previous uses of the locations occupied. The births of almost all new enterprises are immediately and automatically recorded because of their need for credit, and this furnishes a unique reservoir of material for the study. This study may be supplemented later by studies of the reactions of prices to the advent of new enterprises in a partfcular industry as well as the extent to which new or novel products are introduced.

National Bureau of Economic Research, Inc.

The National Bureau's Social Function, the 20th annual report of the National Bureau, describes in detail not only what may be termed its staff program but also the projects sponsored by the Universities-National Bureau Committee. The seven series in which its books are now issued are represented on the cover by the seven colors used for bindings. Two of the colors are anticipatory, but the manuscript of the first volume of *Studies in Cyclical Behavior* will soon be submitted to the National Bureau Directors and the Conference on Research in Fiscal Policy has at last overcome the exigencies of the international situation sufficiently to start one project. D. T. Smith, of Harvard University, with the assistance of Randolph Paul and Bishop Hunt, will study the relation of income as determined for taxation to income as determined for other purposes.

The second child of the Universities-National Bureau Committee, the Conference on Research in National Income and Wealth, held its fifth annual meeting at the National Bureau on April 26–27. The Executive Committee elected for 1940–41 consists of Morris A. Copeland, W. Leonard Crum, Albert G. Hart, Simon Kuznets, Gardiner Means, Robert R. Nathan, and O. C. Stine.

It will be remembered that when the Department of Commerce began current estimates of national income the National Bureau helped by lending the services of Simon Kuznets. Under a similar cooperative arrangement William H. Shaw will spend half his time during the coming year organizing a capital formation unit within the National Income Division of the Bureau of Foreign and Domestic Commerce and supervising the compilation of estimates of commodity flow and capital formation since 1929.

An extension of the National Bureau's productivity studies was made possible last year by an additional grant from the Maurice and Laura Falk Foundation. While Solomon Fabricant is completing studies of manufacturing industries, Harold Barger, formerly of London University and now of Columbia College, will carry forward parallel investigations into non-manufacturing.

National Industrial Conference Board, Inc.

The study, "Public Regulation of Competitive Practices in Business Enterprise," written by Myron W. Watkins, of New York University, in cooperation with the Division of Industrial Economics of The Conference Board, has been released for general distribution.

Studies of "Savings in the National Income," under the authorship of Harlow D. Osborne and Martin R. Gainsbrugh, have recently appeared in issues of *The Conference Board Economic Record*. A forthcoming issue of the *Economic Record* wlll furnish monthly indexes of the cost of living in New York City from 1926 to date.

Investigations of the Twentieth Century Fund

The study of "Collective Bargaining," under the research directorship of Dr. Harry A. Millis, is progressing satisfactorily. Much of the material which will be included in the first of two volumes is already available in draft form, and it is expected that this volume, covering the collective bargaining experience of a number of industries, will be ready to go to press some time during the summer. A second volume, containing a generalized analysis of collective bargaining experience, which will be prepared by Dr. Millis, will be available, it is expected, by fall. It will probably go to press before the end of the year.

The study of the "Economic Effects of Short Selling on the New York Stock Exchange," conducted under the directorship of Dr. Frederick R. Macaulay, has not yet been completed. A considerable part of the text is in substantially final form and Dr. Macaulay is now engaged in completing the statistical analyses.

Most of the field work necessitated in the study of "Relations Between Government and the Electric Light and Power Industry," of which Dr. Arthur R. Burns is research director, has been completed. Part of the text is already in tentative form and it is hoped that the report will be finished by early 1941.

The survey of Housing in Relation to Employment in the United States, authorized several months ago by the Fund Trustees, has been commenced. Mr. Miles L. Colean has resigned his position as Assistant Administrator of the Federal Housing Administration to accept the research directorship of this project. Offices have been established in the Transportation Building in Washington D. C., and a small staff has been assembled. The Committee plans to hold monthly meetings, and detailed plans have been approved which contemplate completion of a report on a part of the survey by early 1941.

CHAPTER ACTIVITIES

The Albany Chapter

The Chapter held a dinner meeting on January 23. Seventy members and guests came to hear a very interesting address by Alfred J. Lotka, Assistant Statistician of the Metropolitan Life Insurance Company, on the subject, "Population Study in Relation to Modern Social Developments." Dr. Lotka emphasized changes in the age distribution of the population, and some of the causes and effects of these changes.

Arvid Burk, Director of the Public Information Service of the New York State Teachers Association, spoke on "Defensible and Indefensible Uses of Statistics of Education" at a meeting of the Chapter on March 25.

On April 23, about forty members and guests attended a dinner meeting on "The 1940 Census." The speaker, H. H. McClure, Executive Assistant of the U. S. Bureau of the Census, reviewed major steps in the preparations for the sixteenth decennial census of the United States, such as the mapping of enumeration districts; the preliminary drafting of schedules; correspondence and conferences leading to helpful suggestions from trade associations, governmental agencies, and other producers and consumers of statistics; training courses given to area managers, supervisors, and enumerators; and the unusual problems of business administration encountered in connection with the printing, mechanical handling, and distribution of many carloads of printed matter for the population census which began on April 1. In the speaker's opinion the recent controversy over the income question was beneficial from the publicity angle, as indicated by the experience of enumerators to date. In response to a question on the item regarding value of production in the Census of Manufactures, Mr. McClure explained that the subject had been given special attention to the end that the item reported would tie in with accounting records of manufacturing establishments.

EDWARD T. FRANKEL

The Austin, Texas, Chapter

The Austin Chapter met for luncheon on April 11, 1940. C. W. Vickery, Chief Statistician of the Texas Highway Planning Survey and President of the Chapter, gave an address on highway economics. Dr. Vickery discussed the concept of highways as a public utility and implications of that concept. Among the topics discussed were (1) estimating the earning power of new facilities, (2) benefits from improved facilities, (3) determination of annual road cost, (4) allocation of road cost to different types of traffic, and (5) economics of the motor fuel tax. Comparisons with the economics of railroad transportation were made. Dr. Vickery called attention to the need for a study of the demand for gasoline and difficulties in the way of such a study.

The Boston Chapter

The twelfth annual meeting of the Boston Chapter was held on February 12, 1940. There were 51 members and guests present. After the dinner there was a business session. The following officers and counsellors were unanimously elected to serve during the ensuing year: President, Theodore H. Brown, Harvard Graduate School of Business Administration; Vice-President, Howard C. Baldwin, Babson's Reports, Inc.; Secretary, Roswell F. Phelps, Massachusetts Department of Labor and Industries; Treasurer, E. L. Quirin, Babson's Statistical Organization; and Counsellors, Charles A. Bliss, Harvard Graduate School of Business Administration, and Nicholas E. Peterson, First National Bank.

The following summary of the addresses was prepared by Wilfred S. Lake, Dean, College of Liberal Arts, Northeastern University:

The general topic, "Statistical Problems of Organized Hospital and Medical Care," was discussed by three speakers: Allan M. Butler, Harvard Medical School; R. F. Cahalane, Executive Director, Associated Hospital Service; and S. B. Stocking, Health Service, Inc.

Dr. Butler, speaking on the subject, "Medical Care in a Changing Society," emphasized the economic difficulties in getting existing medical knowledge to the public due to the expense of modern diagnostic equipment. Since the problem is essentially one of the distribution of medical service, consumers must be organized if costs are to be kept low.

He explained the opposition of the medical profession to consumer organization on the ground that solicitation of patients is involved, a practice which violates a cardinal ethical principle of the profession. At the same time the profession objects to state medicine because it eliminates competition. The solution offered by organized medicine is the operation by state medical associations of statewide prepayment schemes which would be open to any licensed physician and which would provide the free choice of physician by the subscriber.

Dr. Butler, however, believed that the best plan would have to be built around a corps of general practitioners affiliated with a group of specialists and a number of hospitals. To provide the most efficient service both consumers and patients must be educated to use the service intelligently.

In discussing the "Statistical Problems of Group Hospitalization," Mr. Cahalane described the data necessary for the initial determination of rates. These included: age composition of the population, size of families, number of hospital cases, length of hospitalization, and hospital costs. The latter item was particularly important because the plan was based upon the assumption by the hospital of the responsibility of rendering service to subscribers under a contractual arrangement on a non-profit basis.

Efficient administration of group hospitalization requires extensive statistical data permitting the analysis of the experience of the service with respect to types of cases, the age of patients, the ratio of hospital days to member years, the geographical distribution of cases, the relation of the

size and type of group to utilization, etc. In this connection he observed that a high positive correlation existed between the level of intelligence of the group and the proportion of utilization.

Mr. Stocking spoke on the topic, "The Data Needed for Sound Management." He stressed the importance of determining what data were necessary since the collection of utilizable figures is much more significant than the amassing of huge unassimilable quantities of data, and of making provision for obtaining control summary figures as a routine process from the accumulated data.

The problems of obtaining actuarial data were described in detail. Such information is needed by Health Service, Inc., even though it does not undertake to pay definite sums to doctors. Inadequate revenue can not be remedied merely by raising the rates as that might result in adverse selection. Indeed, it might be better to reduce the rates in order to obtain more favorable experience. In view of the vital importance of the cost factor in collecting actuarial data, sampling procedures are essential. He pointed out the close analogy between the actuarial analysis of a health service and market research procedure of industrial enterprises. Short-cut devices were advocated as being practically feasible, such as classing all employees in a soap manufacturing plant as soap workers although many were engaged in other types of activity.

The addresses were followed by active discussion.

ROSWELL F. PHELPS, *Secretary*

The Chicago Chapter

"Business Cycles in Practical Forecasting" was the topic for the fourth meeting of the Chicago Chapter, on February 15, 1940. F. D. Newbury, Economist and Manager of the New Products Division of Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania, was the speaker. Mr. Newbury declared that (1) there is no one business cycle, but several cycles differing in length and other characteristics for different industries; (2) each industry, trade, or financial cycle is a composite cycle of two, three, or more separate and more or less independent component cycles. He concluded with a general forecast for 1940, as follows: "On the whole, 1940 may be expected to be 10–15 per cent better than 1939 and as good as or slightly better than 1937."

Mr. Newbury's address was the product of some years of research in business cycles and he demonstrated his cyclical patterns by means of a large model of his own devising.

Homer B. Vanderblue, Dean of the College of Commerce, Northwestern University, addressed the meeting of March 19. He spoke on "Automobile Pricing Policies," and, as a basis for the discussion, distributed a series of charts reprinted from articles published in the *Harvard Business Review* during 1939. His conclusions were the outgrowth of his service as Consulting Economist of General Motors Corporation in 1938, during which time he was

preparing studies which were later submitted to the Temporary National Economic Committee. An extended discussion from the floor followed his remarks.

Carl Synder addressed a special joint meeting of the Chicago Chapter and The Investment Analysts Club of Chicago on April 1, on the subject of "The Outlook for American Industry—300 Years of Growth and Its Meaning." He illustrated his remarks with many lantern-slide charts reproduced from his recent book, *Capitalism, The Creator*. His main thesis was that national industrial output, national income, and national wealth have grown persistently, decade by decade, throughout the history of this country, and at about the same rate as the growth of capital goods, with the exception of the past ten years; that the capitalistic system, i.e., the search for profit, is the creator of wealth and income, and induces economic progress. As the result of statistical studies of the past few years, he forecast a change of administration in November, followed by the danger of a boom of 1920–1929 proportions unless adequate credit control measures are devised. Many members of the audience, including some members of the press who were present, took advantage of the question period following the address. Mr. Snyder was for many years Chief Statistician of the Federal Reserve Bank of New York and is a Past-President of the American Statistical Association (1928).

"Cost and Demand in the Steel Industry" was Theodore O. Yntema's topic at the meeting of April 30. Dr. Yntema is Professor of Statistics, School of Business, University of Chicago, and Director of Research of the Cowles Commission for Research in Economics. During 1938, Professor Yntema was Consulting Economist for the United States Steel Corporation and supervised the preparation of a series of studies on the interrelation of cost, demand, and price in the steel industry. These studies were later submitted to the Temporary National Economic Committee and since have been published by both the Steel Corporation and the T.N.E.C. Dr. Yntema discussed (1) the responsiveness of purchases of steel to changes in steel prices; (2) the behavior of cost in relation to changes in the volume of output; and (3) the effectiveness of price reduction as a method for obtaining additional sales, production, and employment within the industry. He concluded that there is very little responsiveness of steel demand to price changes because of the very low elasticity of demand for steel products.

As this was the last meeting of the 1939–1940 season, new officers were elected for the coming year, as follows: President, Harold T. Davis, School of Commerce, Northwestern University; Vice-President and Program Chairman, Frank T. Breckenridge, Breckenridge & Company, Investment Counsellors; Secretary-Treasurer, John F. Reinboth, Statistical Engineer, Commonwealth Edison Company; Membership Chairman, Miss Edith M. Brown, Investment Analyst, Chicago Title & Trust Company; and Directors, Henry B. Arthur, Economist, Swift & Company; H. B. Stair, Statistician, Illinois Bell Telephone Company; and Joel P. Dean, University of Chicago.

JOHN F. REINBOTH

The Cincinnati Chapter

The fourth meeting of the Cincinnati Chapter for 1939–1940 was held on the evening of March 14, 1940. The speaker of the meeting was the President of the Chapter, Paul Horst, who is employed in the Personnel Research Department of the Procter and Gamble Company. His subject was "A Modification of the Multiple Regression Technique and its Application to the Measurement of Sales Potentials." The independent variables used by Dr. Horst in his research were car sales, income tax returns, and the number of residence telephones (1935). Raw data were used originally, but better results were obtained when percentages of United States totals were used because territorial differentials in sales were the primary consideration. The usual multiple correlation technique of minimizing the sum of the squares of the deviations of the observed values of the dependent variable from the calculated values was modified by minimizing the sum of the squares of the ratios obtained by dividing such deviations by the observed values. Other modifications involved similar summations, but using ratios calculated by relating the deviations to the calculated values of the dependent variable, and ratios calculated using the deviations and approximate values of the calculated magnitudes of the dependent variable. Dr. Horst had not drawn any final conclusions pertaining to these changes in procedure. The members present discussed the advantages and disadvantages of the methods. The meeting closed with the adoption of a motion calling for the appointment of a nominating committee for officers of the Chapter for the 1940–41 year.

A dinner in the Student Union Building of the University of Cincinnati preceded the fifth meeting of the Chapter held on April 11, 1940. The first order of business was the report of the Nominating Committee. The names offered by the Committee for the officers were: Edgar Z. Palmer, Bureau of Business Research, University of Kentucky, for President; L. M. Welsh, Procter and Gamble Company, for Vice-President; and W. A. Baude, University of Cincinnati, for Secretary. There were no nominations from the floor and the members voted that a unanimous vote be cast for the officers named. Following the election, L. B. Chenoweth, Director of the University of Cincinnati Health Service, spoke on "A Few Statistical Studies in Human Biology." He commented on the studies in which stature of human beings was related to the length of the four principal bones of the body. These bones were shown by means of specimens. Measurements indicate that the height of the human race is gradually increasing. Charts illustrating the trends in height, weight, chest measurement, and other physical attributes of University of Cincinnati students for the years 1920 through 1939 were exhibited. The general conclusion was that the size of the average individual was increasing.

The Cleveland Chapter

The fifth meeting of the 1939–40 season was held on February 13. Russell Weisman, of the *Cleveland Plain Dealer*, gave his views on the economic situ-

ation, answering the question, "How does it look from here?" One of the members humorously remarked that it was Mr. Weisman's annual wet-blanketing of the business outlook.

Mr. Weisman stated that the situation is so uncertain that a forecast was almost impossible. In looking for a parallel to the present situation, the speaker stated that we always have assurances of minor recessions from so-called reputable sources. In 1937 we had assurance for no major recession. At that time the banks were sound and there were assurances that there were no accumulations of inventory, and that the trouble was not world wide. In 1940 we hear the same arguments. It is stated that inventories are not as heavy as in 1936 and 1937.

Mr. Weisman stated that the hopes of the last ten years for bringing us out of the present depression have been largely dissipated. There is no more faith in gold and silver buying. There is no faith through the stimulation of bank deposits. Pump priming, free public expenditures, and deficits no longer answer the prayers. We are bankrupt for ideas for the next stimulation of business. In the annual reviews and forecasts no emphasis was placed on pump priming. Mr. Weisman stated that pump primers assume erroneously that pump priming funds are in addition to other expenditures.

Mr. Weisman thinks that the present slump is a mere extension of the 1937–38 drop, but that the war altered the picture temporarily. He thinks that the only hope for a stimulation in business is a "blitzkrieg" in the spring. He thinks that the war stimulation will be disappointing. The Johnson Act prevents large loans as in the World War. The British are conserving their funds. There has been little liquidation of securities. There can be no great stimulation of exports without credit. He stated that the war may be a washout as far as exports are concerned and that the Allies may be able to restore their own normal export trade. He thinks the duration of the war will be short; that a heavy war is not probable. He thinks that the British blockade is becoming highly effective; that they have prepared for this blockade since 1918. In speaking of peace, or the effect of peace on America, economically, he thinks that one based on freer trade would be quite stimulating.

On March 13, the Business Statistics Section closed its season with an annual forecast of the Federal Reserve index of industrial production. The group forecasts no change in the level of business activity from March through August.

The Columbus Chapter

The Chapter held a dinner meeting on February 21. A group discussion followed the address on "Delineation and Description of the Rural Regions of the United States," given by A. R. Mangus, Professor of Rural Sociology, College of Agriculture, Ohio State University.

At the business meeting of the Chapter on March 20, called to order by Vice-President Daugherty, a motion was made to the effect that the Executive Council appoint a committee to investigate what might be done by the Chapter to prepare an index of statistics available in the state departments.

It was moved and seconded that the committee be appointed, headed by a chairman who is not a state employee.

After the business meeting and dinner, the speaker of the evening, Lester S. Kellogg, Statistician of the Bureau of Business Research, Ohio State University, outlined the statistical resources and the current program of the Bureau of Business Research. He talked at some length about the *Bulletin* issued monthly by the Bureau and the other publications issued from time to time as special studies. During the group discussion, Viva Boothe, Acting Director of the Bureau, contributed additional information about the financial setup of the Bureau and the cooperative arrangements worked out with federal agencies which permit expanded operations on the part of the Bureau.

On April 17, a dinner meeting of the Chapter was held at which Clifford L. James, Associate Professor of Economics, Ohio State University, spoke on "A Statistical Evaluation of the Reciprocal Trade Agreement Program."

The Connecticut Chapter

A joint dinner meeting of the regular and business sections of the Chapter was held on April 17. Halbert L. Dunn, Chief Statistician of the Vital Statistics Division of the U. S. Bureau of the Census, presented an address on "Problems Concerning the Availability of Census Data."

The Harrisburg Chapter

Malcolm H. Dill, Planning Consultant, was the principal speaker for the meeting of the Chapter on February 20. The general topic, "Suburban Growing Pains," was discussed by Mr. Dill with emphasis on regional planning as applied to a metropolitan area.

A paper on "Economic Functions of Consumer Cooperation" was presented by Anthony Lehner, Director of Education for the Pennsylvania Farm Bureau Cooperative Association, at the March 29 Chapter meeting. General discussion followed Mr. Lehner's address.

The New York District Chapter

"Pneumonia and Influenza and Their Control" was the general topic of a meeting of the Chapter on March 19, 1940. The presiding officer and chairman of the committee that arranged the program was Jessamine S. Whitney of the National Tuberculosis Association. Four papers were presented: "A Statistical Picture of Pneumonia-Influenza," by Halbert L. Dunn, M.D., Chief, Division of Vital Statistics, U. S. Bureau of the Census; "The Recorded Mortality from Pneumonia and Influenza in New York City," by Thomas J. Duffield, Registrar of Records, New York City Department of Health; "Type Specific Serum Therapy and Sulfapyridine Therapy of Pneumonia," Wheelan D. Sutliff, M.D., Assistant Director, New York City Department of Laboratories; and "Prospects for the Control of Respiratory Diseases of Virus Origin," by Thomas Francis, Jr., M.D., Professor of Bacteriology, Medical School, New York University. The discussion of the pa-

pers was started by E. S. Rogers, M.D., Director of the Bureau of Pneumonia Control, New York State Department of Health.

A number of study groups have been organized in the New York Chapter to give members of the Chapter an opportunity to meet frequently for the discussion of specialized subjects. The initial meetings of these groups have been very successful, as the following reports indicate:

Industrial Statistics Group

The first meeting of the Industrial Statistics Group was held at the Town Hall Club on February 9th under the chairmanship of Robert W. Burgess who presented a flexible outline of studies for the group's attention in the coming monthly meetings. General topics to be covered will be as follows: (1) Industrial Operating Statistics, (2) Demand for Goods, (3) Industrial Profits, (4) Industrial Costs, and (5) Quality Control.

Mr. Burgess gave an illuminating paper on operating statistics of individual companies. He aptly described the difficulties of constructing indexes of production and sales in volume units, particularly when price changes occurred among products if their proportional contribution to total sales were changing. Characteristics of different industries were described and it was shown that comparison of ratios of investment, sales, profit, etc., to employees would greatly aid such analyses.

WENDELL P. AYRES

"Indexes of Production, New Orders and Inventories" was the topic of a meeting on March 7th of the Industrial Statistics discussion group of the New York Chapter. The chairman, Robert Burgess of Western Electric Company, began the program with some comments on the forthcoming Census, as the most significant current development in the field of statistics. An outline of the basic problems of measuring economic activity was presented by Victor von Szeliski of The Institute of Applied Econometrics. The principal weaknesses of existing overall measures are associated with the lack of data covering several important segments of the economy, the necessity of combining output items with input items in certain fields, and with the units used. Mr. von Szeliski illustrated his points by discussing the construction of the Federal Reserve Board index of industrial production. In conclusion, he pointed out that indexes of production measure past history, and that new orders—while nearer the present—still reflect the results of past decisions. Clyde L. Rogers of the National Industrial Conference Board reviewed the work of that organization in compiling indexes of new orders, inventories and shipments. The selection of the data used, he stated, was based primarily on the ability to obtain figures and only secondarily on qualitative requirements. With increasing interest in such indexes, however, he hoped that qualitative requirements might be given more weight as additional data were obtained. Miss Lucile Bagwell of the Federal Reserve Bank of New York gave a brief description of the Bank's index of the Volume of

Trade, comparing it with the Board's production index. She pointed out that the Volume of Trade included measures of distribution as well as production, that the data used were adjusted for trend and that changing weights were employed.

H. LEBREC MICOLEAU

Business Cycle Study Group

Under the chairmanship of Charles F. Roos, the newly organized "Business Cycle Study Group" held its initial meeting at the Town Hall Club, 123 West 43rd Street, on Monday evening, February 26th. Fifty members were present.

Following a very excellent dinner arranged by Mrs. Helen Slade, Secretary of the New York Chapter, Dr. Roos opened the meeting with an announcement that present plans for the Business Cycle Study Group contemplate a series of monthly meetings at which one or two members, or invited guests, would talk for from three-quarters to one hour each on suitable topics. The topics are to be selected from those suggested by members of the Group and a period for questions and general discussion will be provided at each meeting.

Demonstrating two methods of approach to the study of Business Cycles, Dr. Roos first reviewed certain prevailing business cycle theories, and secondly presented charts showing a number of pertinent statistical indices recently developed by the Institute of Applied Econometrics, Inc., of which he is Director.

Prevailing Business Cycle Theories. Referring to several books published under the auspices of the League of Nations, Dr. Roos first discussed the work of Gottfried von Haberler, as presented in his book entitled "Prosperity and Depression." The theories advanced by Professor Haberler, it was explained, had to do with Money and Banking. The concepts were quite similar to those of Hawtrey. Essentially, Professor Haberler's viewpoint is that continuing prosperity is dependent upon prices and credit rising gradually but indefinitely. Other prominent economists emphasizing Money and Banking factors include Irving Fisher, with his "Debt Deflation" views, and Carl Snyder, who gives special attention to "Rates of Change in Bank Credit."

Dr. Roos next called the Group's attention to two books by Professor J. Tinbergen, both published by the League of Nations. In his book entitled "A Method of Business Cycle Analysis and its Application to Investment Banking Activity," Dr. Tinbergen gave special attention to correlation analysis, particularly with respect to the iron and steel and the construction industries. Such correlation studies attempt to develop the principal factors, such as Rent and Occupancy in Residential Building, apparently influencing business cycle fluctuations. In this book Dr. Tinbergen warns of the fact that over considerable periods of time statistical correlations of a high order would appear despite the lack of logical reasons therefor. Such inter-correlations must be carefully observed and analyzed.

In the second study by Dr. Tinbergen entitled "Business Cycles in the United States" an analysis is made of the probable influence of various factors upon the actual business fluctuations which have occurred in the United States. Among other things, this book considers the effect of such factors as interest, cost, over investment, under consumption, agriculture and special shocks such as war, legislation, etc.

Econometric Indices. Turning from a discussion of prevailing theories, Dr. Roos presented two charts picturing a number of indices that have been developed by the Institute of Applied Econometrics. In the first chart the indexes of greatest interest involved the inter-relationship of Consumers' Demand and New Orders. The Consumers' Demand index is relatively stable and rarely changes from month to month and even over a year it fluctuates moderately. New Orders for Consumers Goods, however, may vary greatly. It was pointed out that in the last six years the fluctuations have been really violent.

In explanation of the meaning of these two indices, Dr. Roos pointed out that "When New Orders gets seriously out of balance with Consumers' Demand, important changes in inventories and production necessarily follow. For example—throughout the last one-half of 1934 and the first half of 1935, New Orders was consistently below Consumers' Demand, which was rising. By the middle of 1936 inventories had been reduced to depression levels, and Consumer Demand was rising sharply, due largely to the Soldiers' Bonus. Then late in 1936 threats of increased prices once more prevailed—a badly unbalanced budget, a spending administration, increasing consumption, and the certainty of increased labor costs and prices. A tremendous excess of New Orders again developed, to be followed by a serious decline."

The second chart was labelled "Capital Goods" and included indices showing the Federal Reserve Board Production Index, Capital Goods New Orders in relation to Consumers' Goods New Orders, and Productive Capacity. It was explained that the level of Capital Goods New Orders tends to fluctuate above or below that of the Federal Reserve Board Index. Booms have culminated in a rush for Capital Goods Orders for several months at a level far above general production. Similarly, depressions have ended after Capital Goods New Orders have remained far below production for a year or more, the length of time depending upon the previous surplus.

Capital Goods New Orders, a series developed by the Institute of Applied Econometrics, is early at the tops of cycles and late at the bottoms. Notice was drawn to the fact that all capital goods booms from 1919 to 1939 began to develop as soon as the Federal Reserve Board Index of Production increased to a level about 5 per cent below Productive Capacity.

This productive capacity index, incidentally, was the source of many questions as to statistical composition, and the center of much discussion as to true significance. As Dr. Roos pointed out, since actual capacity depended on prices, hours of work, management and many other factors, a completely definitive measure of capacity can not be constructed. However, this index, derived by cumulating equipment installations and deduct-

ing depreciation and obsolescence, is useful for indicating the general economic situation.

PHILIP B. STOVIN

On March 25, 1940, thirty-five members and guests of the Chapter attended the second monthly meeting of the group recently formed to study problems of the business cycle. After introductory remarks by the Chairman, Charles F. Roos, the meeting was addressed by James F. Hughes of C. D. Barney and Company, and Courtney C. Brown of Columbia University on the topic "Money in the Business Cycle." This was followed by a general discussion.

Mr. Hughes traced the role of bank credit in business cycles making significant comparisons as far back as 1876 to show that net changes in outstanding bank credit was later reflected in the business trend. This relationship has not been altered by the change in the character of earning assets of the banks that has taken place in the last few years.

Mr. Brown discussed money in the business cycle from the standpoint of its theoretical function saying that money affects the economy most when it fails to function perfectly as a store of value. Expectation of change in the price level causes a change in the attitudes of those having money so as to cause spending or hoarding. Mr. Brown also discussed available methods of using our monetary and credit mechanism in a positive way to control price relationships, concluding that it would require such a high degree of coordination among our banking, fiscal and security market agencies to achieve such control as is practically impossible.

KARL N. EHRICKE

Statistical Techniques Group

The first meeting of the Discussion Group on Statistical Techniques, Helen M. Walker, Chairman, was held on February 15th at the Men's Faculty Club, Columbia University. The evening's discussion was on Sampling. W. J. Youden of the Boyce Thompson Institute for Plant Research discussed a series of interesting sampling problems in the fields of biology and soil chemistry. His illustrations all pointed to the practical efficiency which can be realized when the methods of collecting data are specifically related to the techniques of analysis.

The second meeting of the group was devoted to a discussion of "Sampling Problems of the 1940 Census." W. Edwards Deming, Senior Mathematician in the Population Division of the Bureau of the Census, described the sampling procedure which the Census Bureau adopted for obtaining supplementary information in the Population Census and presented the mathematical basis of the method.

The speaker at the third meeting of the group was Joseph Lev of the Municipal Civil Service Commission who discussed "Maximum Likelihood as Applied to Statistical Estimation."

The Philadelphia Chapter

At a meeting of the Philadelphia Chapter on February 23, Jakob Marschak, Professor of Economics on the Graduate Faculty of the New School for Social Research and Head of the Statistical Institute of Oxford University, discussed the subject of "International Economic Agreement and Lasting Peace." A considerable part of the discussion centered around the development of national economic and monetary objectives and the political conflict engendered by the mechanisms employed toward achieving these aims. Some of the questions arising in this connection comprised the practicability and the political ramifications of national self-sufficiency through barter or two-way trade and protective tariff systems, the problem of full employment in normal peacetime as against militaristic production, the adoption of internal price stability at maximum or optimum productive levels as against external stability in the value of money as a monetary objective. Also discussed were such important problems as maldistribution of resources and incomes, concentration of gold in the United States, and the feasibility and desirability of widespread international credit agreements.

The Chapter met on March 29 to discuss, "Some Aspects of Population Movements in the Immediate Future." P. K. Whelpton, Associate Director of the Scripps Foundation for Research in Population Problems, spoke. The time was devoted primarily to consideration of changed and changing age distribution in the population of the United States and shifts in the geographic distribution of population, chiefly as between rural and urban districts. Dr. Whelpton had calculated projections of the total number of the population and for changes in the distribution, and upon this basis he led the discussion of economic and social changes which may arise as a result of the alteration in the characteristics of the population. The discussion was particularly interesting from the standpoint of government fiscal operations, production, and marketing, as current population trends may have widespread effects upon the nature of consumption, the type of advertising appeals to be made, the type of products to be manufactured, the social characteristics of the community, and the incidence and end-product of the national tax structure.

ROBERT R. WILLIAMS, *Secretary*

The San Francisco Chapter

A dinner meeting of the Chapter was held on February 29. Murray R. Benedict, Professor of Agricultural Economics, Giannini Foundation, University of California, spoke on "The British 'Trading Estate' Program as an Aid in Increasing Employment."

Eugene L. Grant, Associate Professor of Economics of Engineering, Stanford University, presented an address on "An Engineering Viewpoint on Depreciation" at the dinner meeting of the Chapter on April 11.

The Washington Statistical Society

The Washington Chapter now has about 700 members. It is very difficult to arrange a single program which will appeal to the majority of this group because of the diversity of their statistical interests. The program committee decided to arrange three meetings on separate subjects for the same evening. This experiment, which was tried twice, seemed to work very well.

The first of the "three-ring meetings" was held on the evening of February 13. Frederick F. Stephan, Secretary of the American Statistical Association, and Morris H. Hansen, Bureau of the Census, discussed "Sampling Techniques and the Census." William F. Callander, Department of Agriculture, acted as chairman of this meeting, and W. Edwards Deming was discussant. "Practical Problems in Research Undertaking" was the subject of another section of the meeting. Samuel J. Dennis, Bureau of Foreign and Domestic Commerce, was chairman of this meeting, while Day Monroe, Bureau of Home Economics, discussed the problems connected with "Conducting the Consumer Purchases Study," and John L. Martin, Bureau of Foreign and Domestic Commerce, discussed the practical problem of "Measuring the National Income." The third section of the meeting was devoted to "Statistical Studies of the Division of Public Health Methods, National Institute of Health," and I. S. Falk, Social Security Board, acted as chairman. Selwyn D. Colllins discussed "Morbidity Surveys," Harold F. Dorn spoke on "Population Studies," C. Mayhew Derryberry, "Studies of Visitor Reactions to Health Exhibits," Carroll E. Palmer, "Nutrition Studies," and George St. J. Perrott, "Medical Care Studies."

Approximately 200 members attended one or more of the abovementioned meetings. The main criticism directed at the meetings was that the subjects were not diversified enough, so that an individual would only care to attend one meeting.

The program committee decided to have another "three-ring meeting," which was held on March 7. One section of this meeting was devoted to a discussion of the "Derivation and Use of Demand Curves in Agriculture," with Josef Solterer, Georgetown University, as chairman, and F. L. Thomsen, F. V. Waugh, and Meyer A. Girshick, all of the Department of Agriculture, as speakers. The second section of the meeting was devoted to the discussion of the "Concepts and Measurements of Economic Phenomena," with Clark Warburton, Federal Deposit Insurance Corporation, as chairman. George Terborgh, Board of Governors of the Federal Reserve System, discussed "Capital Formation" and Raymond W. Goldsmith, Securities and Exchange Commission, devoted his discussion to "Savings." "Problems of Experience Rating in Unemployment Insurance" was the topic of the third section of the program. Howard B. Myers, Work Projects Administration, was chairman of this section and Raymond C. Atkinson, Social Science Research Council, and A. D. Studybaker, American Retail Federation, were speakers.

The meeting held on April 2 was devoted to the subject, "The Development of Sampling Techniques in the Field of Agricultural Statistics," with Charles F. Sarle, Director of Economic Research of the Commodity Credit Corporation, formerly of the Agricultural Marketing Service, as chairman. Archie R. Sabin, Agricultural Marketing Service, discussed methods of "Improving Estimates of Farm Employment," and Walter A. Hendricks, also of the Agricultural Marketing Service, discussed "Assumptions Involved in Use of Crop Meter for Sampling Acreage," while Arnold J. King, Agricultural Marketing Service, Ames, Iowa, discussed "New Developments in Agricultural Sampling Techniques."

HAROLD D. KUBE, *Secretary*

BOOK REVIEWS

GLENN E. MCLAUGHLIN
Review Editor

Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process, by Joseph A. Schumpeter. New York: McGraw-Hill Book Company, Inc. 1939. Vol. I—xvi, 448 pp. Vol. II—ix, 449–1095 pp. $10.00.

Schumpeter's theory of the business cycle dates back at least to the year 1911 and his work, *The Theory of Economic Development*, was made available in English in 1934 in a somewhat abbreviated form. This theory bases its explanation of the cycle upon periodic introduction of innovations into the system by a "cluster" of new entrepreneurs with the aid of credit-expansion. The present book tries to substantiate the earlier work without entirely replacing it; the author refers to it several times as being in some ways a more precise and more closely reasoned exposition of his views. The new book is at the same time an empirical investigation endeavoring to present the full background for the theory. Yet, it is much more since it takes up a great number of theoretical and statistical issues which at the earlier date were not yet ripe for examination. Large parts of the work are of a descriptive-historical character, but this history is written with constant reference to its theoretical significance, hence goes well beyond mere faithful account of economic change since 1787. The extensive statistical material is interspersed in this history and presented principally in form of graphs, in which the most important items available for the United States, Great Britain, and Germany have been included. In presenting these statistics unfortunately there has been no application of the elaborate measurements specifically developed for business cycle analysis such as those used for example in the work of the National Bureau of Economic Research or in the League of Nations Studies. Therefore, while they have the agreeable character of more or less helpful illustrations, it is to be doubted whether they have independent importance. The graphs moreover frequently lack scales and bases of indices and hence are not always easily read. Detailed appendices, however, enable the reader to make a somewhat more extended use of the valuable computations. Prof. Schumpeter has very much to say about statistical methods and the statistician will find Chapter V on "Time Series and Their Normal" of exceptional interest. He may also study with great profit the role which the author attributes to various waves other than the business cycle as generally understood.

There is no doubt that this is one of the most outstanding publications in its field. In its vast scope the work has few parallels; indeed it is much more than a study of the business cycle. The problems it attacks are scientifically significant and though in the course of study of its more than 1000 pages the reader necessarily finds much to debate it will chiefly be for the reason that

the questions raised must for a long time to come require the sincere collaboration of the best minds.

OSKAR MORGENSTERN

Princeton University

Turning Points in Business Cycles, by Leonard P. Ayres. New York: The Macmillan Company. 1939. xiii, 214 pp. $2.75.

"This book," says Colonel Ayres in the preface (p. v), "is the account of a study undertaken in the attempt to find out why the expanding production of durable goods turns downward at the top of prosperity and begins to contract, and why it stops shrinking at the bottom of depression and turns upward and begins to expand once more." Colonel Ayres then proceeds with the aid of 25 diagrams and numerous tables to trace cyclical fluctuations of American business since 1830 and combines these historical and statistical analyses with theoretical considerations to obtain answers to these questions.

The author's general conclusion is given in the preface (p. vii):

> Throughout this book the evidence has supported the central thesis that turning points in business cycles normally result from changes in the volumes of inflows of new funds into business enterprises. In most cases these changes are internally generated by the interactions between and among the reserve ratios of banks, the levels of interest rates, the trends of security prices, and the alternating expansions and contractions in the volumes of new security issues. This means that our business cycles have generally been caused by the operations of our banking laws and regulations, our business procedures, and the processes of our security markets.
>
> Sometimes the forces that have brought about the turning points in business cycles have been externally generated by such developments as the outbreaks or the conclusions of wars, or by business developments in other countries. Nevertheless, an analysis of the evidence over the long period under review leads definitely to the conclusion that turning points in business cycles, whether resulting from forces internally generated or from external forces, are brought about in almost all cases by increases or decreases of the inflows of new money into business enterprises.

Much of the book is devoted to historical and statistical evidence which led to this conclusion. The last sentence of the book is, "The cause of business cycles seems to be the changes in the flow of new money into business enterprises."

Colonel Ayres discusses a problem of special current significance in Chapter X, "Consumer Purchasing Power," and Chapter XI, "Pump Priming Recoveries." In the former chapter he states (pp. 100, 101), "This chapter offers two chief conclusions. The first is that the evidence of diagram 13 Factory Production of Consumers Goods and Volume of Security Issues indicates that theories of business cycles that are based on alleged insufficiency of consumer purchasing cannot account for business cycles in this

country during the past 40 years. The chief reason why changes in consumer purchasing, or in purchasing power, cannot account for the downturns and upturns of business cycles is that in nearly all the cases of cyclical turns of business activity, important changes in the volume of investment took place earlier than the turning points in the production of consumers goods or of all manufactured goods. The other chief conclusion of the chapter is that changes in the degree of business activity are caused primarily by changes in the volume of business spending." This is *post hoc* reasoning.

In Chapter XI the author criticizes Mr. J. M. Keynes' argument in favor of pump priming, and writes (p. 108), "There seems to have been a fundamental error in Professor Keynes' theory of pump priming recoveries. He recognized and stated that the huge total of new spending would largely go into consumption goods. And then he stated that in order to meet those increased demands for goods, manufacturers would have to enlarge their plants and improve and increase their equipment, and the self-sustaining recovery would get under way. There is the weak link in the chain of reasoning. The fact is that manufacturers do not have to increase their plants greatly, or to improve their equipment much, in order to produce volumes of consumers goods that are no greater than those that they were recently producing. It did not require much additional equipment to produce in 1937 as large a volume of consumers goods as had been produced in 1929. It required repairs and replacements and not much more than that. That is the dilemma that confronts a pump priming recovery."

Overlooking the fact that this dilemma confronts *any* recovery, whether "artificial" or "normal," the author continues, "The increased production that causes normal self-sustaining recoveries does not result from current consumer spending. Effective recovery production consists of important increases in the output of goods that we know as producers goods, or capital goods, or producers durable goods."

Colonel Ayres goes on to observe that the Erie Canal, railroads, the automobile, the telephone, the telegraph, typewriters, electric power, motion pictures, radio, iceless refrigerators, rayon, and so on were not created and developed in response to current spending but because bold and enterprising men have had faith that future spending could be stimulated into being and that profits could be derived from it.

The proposition that *in the past* cyclical fluctuations in security issues usually have preceded cyclical changes in the production of consumers goods may be true. However, the fact that in the past the country has had to wait for recoveries until daring entrepreneurs decided that Erie Canals, railroads, and automobiles gave enough promise of future consumer spending to make the investment worth while is no valid reason why recovery must of necessity be left to so fortuitous a process.

Indeed Colonel Ayres himself makes a surprising concession (on p. 112), in view of his preceding argument, when he writes, "Economic pump priming can never be more than a temporary process. It cannot succeed in re-

storing prosperity unless the business mechanism of the country is in good working order. There is one condition under which a federal spending program might contribute to bring about a lasting business recovery. That condition is the creation by the Federal Government of cooperative relations between itself and private enterprise that will create confidence in the prospects for future profits." The psychological considerations pertaining to the questions are of course the crucial considerations determining the effectiveness of a pump priming program.

J. PHILIP WERNETTE

Graduate School of Business Administration
Harvard University

Statistical Method from the Viewpoint of Quality Control, by Walter A. Shewhart with the editorial assistance of W. Edwards Deming. Washington, D. C.: Department of Agriculture Graduate School. 1939. ix, 155 pp.

Dr. Shewhart has made a distinct contribution to the field of applied mathematical statistics. This contribution can be appreciated best by those who are acquainted with his work. His newest book, "Statistical Method from the Viewpoint of Quality Control" enhances this contribution.

The book is not intended for beginners. It is written for graduate students of the subject and is very thought provoking and instructive. The reader must be well versed in the particular branch of statistics in which Dr. Shewhart is a leader if he is to get the most out of the book. However, the book is very readable and will repay study by the beginner if for no other reason than to learn not to draw too hasty conclusions from too meager data.

The author starts out by stating that there must be three steps in any quality control program—1) specification, 2) production, 3) and inspection. The rest of the book deals with how samples may be drawn from a universe and what we can expect to learn about the universe from observation of the samples. The author spends considerable time impressing upon the reader the fact that he can never be sure he is drawing the samples at random. This is because of the ever present assignable causes which creep into any chance cause system. This is true in spite of the fact that observations are made under identical conditions. In this respect the author does not hesitate to question the methods used by our most careful observers, our research workers, in arriving at their conclusions. He makes the statement, by implication, that the values of physical constants, such as "g" (gravitational constant) should not be considered as accurate unless observations are shown to be made under conditions of statistical control. On page 65 he says, "engineering and research data are not to be regarded differently with respect to the assumption of statistical control."

All this does not necessarily mean that the book is in any way controversial. Quite to the contrary, it offers sound advice to the mature statistician. It warns him of pitfalls to be avoided in drawing conclusions from statistical

calculations and gives hints on how to avoid them. However, the book contains no formulae and the reader must bring his own solution to his problem if he finds that he has been on the wrong track. In this respect the book is not a text. Although problems are used to illustrate the subject matter, the reader should be prepared to follow the author in his conclusions, because no detailed solutions are given. It is not a book to be read in an evening; rather, it is one to be enjoyed during a lifetime, and it will be a valuable addition to the library of any statistician.

The author stresses the importance of statistical control in order to make the best and most economical use of materials. From this point of view the industrialist might do well to study the book carefully. He emphasizes the point that assignable causes are, for the most part, those that come and go in erratic fashion. While the manufacturing engineer readily admits the erratic part, he has not been willing to trust statistics as an indicator of assignable causes. To him especially we recommend Dr. Shewhart's Statistical Method.

JOSEPH MANUELE

Westinghouse Electric and Manufacturing Co.

Mathematical Analysis for Economists, by R. G. D. Allen. New York and London: The Macmillan Company. London School of Economics and Political Science, Studies in Statistics and Scientific Method, No. 3. 1938. xv, 548 pp. $9.00.

This book is an important contribution to the materials for the teaching of economics.

In a single volume the author leads us from the basic ideas of numbers and variables, through the theory of functions with special attention to their derivatives and the conditions for maximum and minimum values, to the sophisticated concepts of the calculus of variations. In the process, most of the methods of mathematical analysis necessary for economic theory are developed. The illustrations of the mathematical treatment of economic problems are fairly comprehensive and afford a good introduction to recent studies in this field. Each chapter is supplemented by a series of exercises, many of them economic in character.

Despite its extensive range of subject matter, *Mathematical Analysis for Economists* is a remarkably readable book. The attention to detail is meticulous, but, at the same time, the exposition is interesting and lucid. Although so broad a survey cannot treat each subject exhaustively, it is surprising to find how adequately the individual topics are discussed. As a necessary consequence, however, ideas are presented so rapidly that most readers will require frequent pauses and considerable review and practice on the exercises.

It is easy to suggest additions to such a treatise, much of whose merit depends on the excision of the irrelevant. Nonetheless, I wish the author had

seen fit to include a section on the mathematics of inequalities and the use of graphic methods in problems of this type. The chapter on determinants, in my opinion, is too limited in scope. And the text might well have been extended in a few places to include the mathematical theory needed in statistics.

These suggestions do not, however, belie the conclusion that Mr. Allen has done a difficult piece of work extraordinarily well. His book will be most valuable both as a text and reference work for many students of economics.

THEODORE O. YNTEMA

Cowles Commission
The University of Chicago

Mathematical Tables, Volume VII, The Probability Integral, by W. F. Sheppard. New York: The Macmillan Company. Cambridge: Cambridge University Press. Published for the British Association for the Advancement of Science. 1939. xi, 34 pp. $2.50.

This volume, with an introduction by Dr. J. O. Irwin, has been published by the British Association as a memorial to the late Dr. William F. Sheppard 1863–1936). A more fitting memorial to Dr. Sheppard's scholarly work in mathematical statistics and to his great services to the practical computer in the preparation of tables of the normal probability integral, it would be difficult to imagine. Sheppard's first tabulation of the probability integral, carried to 5 places only, appeared in 1899, his second carried to 7 places, in 1902–3. In 1906–7 appeared the Galton-Sheppard tables giving x in terms of $\frac{1}{2}(1+\alpha_x)$, and in 1914 Sheppard published a table of $-\log \frac{1}{2}(1-\alpha_x)$. All these are to be found in *Tables for Statisticians and Biometricians*, Part I (1914, 1924). Previous tables had used as argument the modulus, $x/\sigma\sqrt{2}$, but Sheppard introduced the use of the more convenient x/σ. For many years, he had planned to prepare a volume of tables of the probability integral carried to as many decimal places as would ever be needed. He had completed Table II, with argument x/σ at intervals of 0.1, and with tabular entry carried to 24 decimal places. "It is an example of the remarkable accuracy of Sheppard's work that not a single error was discovered in any of the entries of Table II." To facilitate interpolation in this Table, he had (computed reduced derivatives $f_{(n)}x = (h^n/n!)f^n(x)$ up to the 16th for values of the argument less than .9, and up to the 13th for larger values. Tables III, IV, and V he had computed from the fundamental values in II. Table I was obtained by subtabulation from II but had not been completed by Sheppard. The Committee for the Calculation of Mathematical Tables had this table completed, all the others checked, and Table VI added.

Three functions of the normal probability integral are tabled, the ratio of the tail area to its bounding ordinate in Tables I and II, the negative natural logarithm of the tail area in III and IV, and the common logarithm of the tail area in V and VI. Interpolation is facilitated by the provision of reduced derivatives in I, II, IV and V, and of second central differences in

VI. In each table the argument $t = x/\sigma$ extends to 10.0. The width of interval in the argument and number of decimal places in the tabular entry are as follows:

Table I, interval 0.01, entries to 12 decimals,
Table II, interval 0.1 entries to 24 decimals,
Table III, interval 1.0 entries to 24 decimals,
Table IV, interval 0.1 entries to 16 decimals,
Table V, interval 0.1 entries to 12 decimals,
Table VI, interval 0.01 entries to 8 decimals

Helen M. Walker

Teachers College
Columbia University

Statistik als ein Erkenntnismittel der Wirtschaftspolitik, by Fritz Huhle. Jena, Germany: Gustav Fischer. 1938. vi, 158 pp. RM 6.

The ambitious title "Statistics as an Analytical Tool of Economic Policy" is misleading. If the reader expects to find a systematic analysis of how statistics can be utilized for the purpose of economic policy, he will be disappointed. The author has picked up rather arbitrarily some problems, leaving completely out of consideration some others which might be regarded as equally if not more important.

The book is divided into three parts. In the first the author describes how the increasing complexity of modern economic life necessitated the building of various institutions for collecting statistical data in order to make possible quantitative insight into the interwoven economic relations. The second part deals with the appropriate tools of statistical analysis, and the third, with the validity and limitations of statistical analysis insofar as it may serve the ends of an economic policy.

The main part of the book is devoted to logical and methodological problems. Unfortunately, the meaning of various statistical methods is not sufficiently thoroughly analyzed. Since the author published a doctoral dissertation on the representative method but a few years ago, one would expect at least a reliable analysis of the different approaches in this field. In the chapter dealing with the representative methods the author reveals, however, no familiarity with the general mathematical theory of sampling, nor with the specific approach of stratified sampling, particularly adapted to economic statistics. Strangely enough, index numbers are treated in the chapter on causal evaluation of statistical analysis. Under such circumstances it is even more surprising that the author hardly realizes what role the composition of index numbers may play in testing immediate and more remote effects of various measures of economic policy. Methods and problems concerning the estimation of national income are not analyzed at all.

In the concluding part the author tries to determine the limits of the utilization of statistics for the purpose of economic policy. The remarks are

in general sound but the author fails to give a clear cut presentation of the logical problems involved. The book is poorly organized and shows an unpardonable neglect of recent literature.

EUGEN ALTSCHUL

University of Minnesota

Consumer Expenditures in the United States, Estimates for 1935–36. Washington, D. C.: National Resources Committee. 1939. ix, 195 pp. 50 cents.

This monograph is the most comprehensive study of American consumption yet attempted. Prepared by the Consumption staff of the National Resources Committee from data secured by the Consumer Purchases Study, it estimates the consumption patterns of families and single persons for 15 income groups and 16 budgetary items in terms of average and aggregate outlays in 1935–36. Thus it becomes possible for the first time to derive income-expenditure curves for the whole country, to estimate the amount spent for current consumption and savings, to indicate to what extent various income groups share in consumption and savings, to mention only a few possible uses of the data. The conclusions are presented in similar form to that used in the previous report on Consumer Incomes, showing average expenditures for various items and savings for consumer units, families and single individuals in terms of thirds and tenths of the nation's population.

The validity of the estimates and the conclusions based upon them depends upon the nature of the original sample and the assumptions and methods used in extending the sample data to apply to the whole population. No one is more aware of this than those who prepared the estimates. The original sample, the assumptions made, the methods used are clearly explained in the Appendices and often referred to in the text. Since the sample data were small (42,000 of the 60,000 expenditure schedules collected were utilized; data from 7 cities and 10 farm counties were omitted) a great many assumptions had to be made. The Consumption Staff believes that the sample was sufficiently well selected and the assumptions adequately enough checked to make the final estimates roughly correct. Tests appear to indicate that the omission of some of the original data had little influence on the results; that the assumption of the similarity in expenditure patterns of regional, occupational, and color groups was not unreasonable in most cases.

The most questionable part of the study is undoubtedly the analysis of the income, expenditures, and savings of the upper income groups. There were only 90 expenditure schedules available for the $10,000 to $15,000 income group, 21 for incomes of $15,000 to $20,000 and 15 for incomes of $20,000 and over. Savings estimates for these groups are particularly doubtful since they had to be made largely by extrapolating the data of the lower income groups within maximum and minimum limits. Since some of the most interesting conclusions of the report refer to differences in consumption and savings between the lower and higher income groups, the inadequacy of

these data becomes of considerable significance. The material for single individuals and relief families was also fragmentary, necessitating a great deal of estimation in determining the final figures.

It is easy to pick flaws in a titanic statistical attempt of this sort and I do not wish to seem overcritical. There is no doubt that this is the best and most comprehensive study of our national income and expenditure that has so far appeared. The difficulties involved are there for all to read, and they must be taken into account by all who expect to use the final estimates. These estimates cannot be accepted as yet as anything but very rough approximations and should not be used except in the light of their derivation. They are very much more dubious than conclusions drawn from the original data in terms of the regions or occupations which they directly represent.

If the income-expenditure distribution of the country as presented in this report is even approximately correct, the implications are of great importance. These figures show that negative savings occur on the average up to an income level of $1250 and that the majority of the families and individuals in the lower and middle third of the population spend more than they earn on current consumption. Yet the savings of the upper third were sufficient to provide a net total of $6,000,000,000, or 10 per cent of income in 1935–36. The upper third also dominate the consumer market, since they account for 50 per cent of total food consumption, more than half of housing, clothing, medical care, and personal care, and over 70 per cent of recreation, automobile, and education expenditures. The lower third share in consumption to a very limited extent, much below their share in the population. Another point of interest lies in the absolute increase in expenditure for every consumption item which occurs as income rises.

One of the most interesting sections of the study is Appendix C which presents a hypothetical analysis of what would happen to the consumption pattern of 1935–36 if size and distribution of income changed. Various cases are set up for examination; such as the effect of differences in size alone, of differences in size and distribution together, of differences in proportionate distribution alone. Perhaps the most interesting possibility which emerges from this theoretical exploration is the extent to which the income distribution must apparently move towards equality in order to keep relative savings constant.

In summary, the material and analysis in this monograph should prove of great concern to economists, statisticians, business men, and many others. It provides grist for the mill of theorists in the spending-savings controversy as well as the best evidence so far available on consumption in the United States. It should be the forerunner of many additional statistical and theoretical investigations in the field.

Elizabeth W. Gilboy

Committee on Research in the Social Sciences
Harvard University

Studies in Income and Wealth, Volume Three, by the Conference on Research in National Income and Wealth. New York: National Bureau of Economic Research. 1939. xxiii, 479 pp. $3.50.

The third volume of the National Income and Wealth series turns to the empirical and quantitative phase of the Conference's investigations. Whereas the preceding volumes dealt with concepts and conceptual problems of meaning, definition, and measurement, Volume III seeks to analyze the national income or wealth total in terms of its significant components. Three of the seven papers and discussions treat of personal distribution by size of income received or wealth held. In reviewing the several American studies in the field C. L. Merwin Jr. notes the viewpoint of each investigator and the materials and methodology ("daring feats of ingenuity," p. 85) employed. Most of the second paper—by Charles Stewart—concerns the income-capitalization method of estimating wealth holdings, particularly the Fritz Lehmann variant which results in estimates of total net estates as derived by use of the capitalized value of dividends received by persons in different income classes (see pp. 108, 131, and 144). Enid Baird and Selma Fine next review the adaptations and adjustments of Federal income tax information that were made in using such information for the higher income classes in the consumer income estimate of the National Resources Committee. The exposition throws into bold relief such limitations as result from pairing for family totals the returns of richer husbands and richer wives and from making sweeping adjustments for nonreporting and understatement.

A fourth paper by R. W. Goldsmith, assisted by Walter Salant, develops estimates of savings in the United States, 1933–1937, in terms of individuals' savings or dissavings of different forms (liquid, absorption of securities, durable consumers' goods) as well as those of business and government. Clark Warburton next presents a detailed comparative analysis of the recent studies of the nation's output of commodities and services made by W. H. Lough, Simon Kuznets, and Clark Warburton. The state distribution of income is considered in the last two papers: R. R. Nathan reviews several questions bearing upon the allocation of national income among states and P. H. Wueller considers the possibilities of using state income data in distributing Federal grants among states.

The several parts of Volume Three contain a wealth of considered thought and fact on particular subjects and reflect careful preparation on the part of qualified persons. The competence of the discussions following the various statements adds materially to the value of each even though the net number of commentators is limited. For what it is the book recommends itself. At times the reader may be moderately disturbed by recurrence of the fruitless question of whether income distributions are more significant than wealth distributions, a Lorenz curve display based on rich-to-poor rather than poor-to-rich cumulations (cf. pp. 10 and 132), reliance upon cumulated data for exhibit and analytic purposes, and assertions regarding inequality in

personal distribution without adequate definition of the concept (cf. pp. 121 and 139).

Dwight B. Yntema

Work Projects Administration

Normal and Abnormal International Capital Transfers, by Marco Fanno. Minneapolis, Minnesota: University of Minnesota Press. November, 1939. xi, 120 pp. $2.00.

This compact monograph on international capital transfers is the first of a series of studies in economic dynamics which the University of Minnesota plans to publish. The editors propose to confine the series primarily to analytical or theoretical treatments of economic problems which may be roughly characterized as cases of disequilibrium. Other criteria for the selection of studies include the development of new analytical approaches, the systematic recapitulation and synthesis of existing unorganized analyses, and distinguished scholarship not restricted by nationalistic and linguistic barriers. The objectives set by the editors and the selection of Professor Fanno's work as the first of the series are commendable.

The monograph is the result of a substantial revision of an earlier study published by Professor Fanno in Italian (I Trasferimenti Anormali dei Capitali e le Crisi—1934). After a brief introductory analysis of capital transfers, Professor Fanno in Chapter II sets forth the specifications of normal transfers. They include transfers which arise because of differences in the net rate of interest prevailing in various countries, which do not exceed the amount of voluntary savings available for export, which are effected principally in commodities and services, and which have in general an equilibrating tendency. On the basis of these specifications, especially with an equilibrium interpretation of a net rate of interest and voluntary savings, the reviewer is inclined to say that the world's capital transfers have been almost entirely abnormal. Apparently Professor Fanno holds a different point of view.

In the remainder of the book two fundamental groups of abnormal capital transfers are analyzed, namely, indemnities and repayment of war loans, and flights of capital. Although the analysis of the former is brief and in general terms, the presentation especially with regard to the difficulties of transfer which are not automatically solved by the collection of funds is excellent. Since the author states that the limits may vary widely in the collection of funds depending on the standard of living which the debtor state intends to maintain for its population, the use of criteria for judging willingness to pay would have improved this part of the analysis.

The treatment of flights of capital, the freezing of foreign debts, and crises cannot be justly evaluated in a short review. Students of these problems will find it helpful. One point, however, puzzles the reviewer. Professor Fanno

recognizes the controversial character of the concept, cycles or periods of production, but uses it to explain the slow thawing out of frozen assets. The struggle for liquidity and its repercussions are not technological problems. Claims to equipment or half-finished inventories may be sold at bargain prices. Finished inventories on hand, moreover, do not fit into the analysis. For dynamic economic analysis the use of this concept is difficult to justify.

In the final chapter Professor Fanno notes that Ricardo's theory of the distribution of the precious metals does not apply to existing conditions and seems to imply that conditions should be modified to fit the theory in order to eliminate paradoxical situations. Perhaps these paradoxes would evaporate if examined not in terms of Ricardo's theory, but in terms of the accomplishments of present monetary techniques in a changing economic world.

CLIFFORD L. JAMES

The Ohio State University

International Monetary Organisation, by Michael A. Heilperin. Paris: League of Nations, International Institute of Intellectual Co-operation. New York: Columbia University Press. 1939. 61 pp. 75 cents.

In this book, prepared as one of a series of monographs concerning "economic policies in relation to world peace," Dr. Heilperin attempts "to define the principal issues in contemporary monetary policy in their relation to the problem of world peace." The first chapter outlines the two issues "at the center of the contemporary monetary dilemma," first that of free exchange markets versus exchange control by government, and secondly that of fixed versus fluctuating exchange rates. Economic internationalism is here defined as a "policy intended to prevent political boundaries from exercising any disturbing effect on economic relations between the areas on the two sides of the frontier." The conditions under which monetary internationalism can operate are linked with long-run equilibrium in the balance of international payments. A deficit in the country's foreign payments can be remedied through (a) increase in exports or decrease in imports, (b) increase in new borrowing, and (c) default on foreign obligations; and *contra* for a country having a surplus.

In analyzing the effects of State control of economic activity upon international monetary organization, Dr. Heilperin concludes that in a "compromise between free and regulated economies," the tendency is to "make free economies less free rather than to reduce control in the regulated ones." Motivation for such control, except in Soviet Russia, rests on imperialism and war preparations. The disintegration and collapse of monetary internationalism are blamed upon the lack of co-operation. "The gold standard implied deflation [after 1930] only because there was no agreement between the gold standard countries regarding a joint policy of expansion. If properly understood, the adoption of an international *monetary* standard

calls for *economic* co-operation as well." Recommendation of funds, set up to maintain exchange stability and to offset and sterilize the effects of gold flows seems to this reviewer to be aimed at just what central bank policy attempted (and failed) to do in the 'twenties. Dr. Heilperin pricks the oft-repeated myth that the choice is between "stability of prices" and "stability of parities"; the "insulation" sought rests upon the "idea that national planning can eliminate business cycles."

Dr. Heilperin suggests that a "*pact of co-operation*" should be so set up as to reward co-operation and penalize non-co-operation. "It is in the interest of World Peace that the attainment of economic independence should be made as difficult as possible."

JAMES D. PARIS

Great Neck, New York

Golden Avalanche, by Frank D. Graham and Charles R. Whittlesey. Princeton, New Jersey: Princeton University Press. 1939. xv, 228 pp. $2.50.

As the authors point out in the preface to this volume, they do not write as advocates of "any specific plan of action" with regard to the present gold problem. They do, however, touch upon, in one way or another, almost every specific plan that has so far been advanced to deal with the current international monetary issue.

The volume begins with an analysis of the factors influencing the supply of and the demand for gold and advances the thesis that there is no practical possibility of an automatic correction of the present disequilibrium between the supply of, and the need for, gold and the present disequilibrium in the distribution of gold between countries. The remainder of the book is concerned mainly with the way in which the present gold problem developed and the question of what, if anything, can be done to improve the position of the United States with regard to its gold supply.

It is clear to the authors that a continuation of the present gold-purchase policy involves a cost to our domestic economy of intolerable proportions—intolerable, certainly, in the light of the benefits of the policy. It is made less clear how this cost manifests itself. It might, perhaps, have been better for the whole drift of the argument if the discussion of the "cost" of the gold-purchase program to the American people had been placed at an earlier point in the volume rather than in its last pages, for some degree of uncertainty seems to run throughout the text on this important question. Indeed, the discussion of "cost" seems much less matter-of-fact than most of the argument of the book. It appears, to this writer, that the arguments advanced do not demonstrate that "the cost of acquisition of useless gold takes effect in lowering the general standard of living of the community" nor, indeed, that the community's "opportunity for a higher income (is) frustrated by definitive purchases of gold." The fact that much of the cost, whatever its eventual magnitude, has not yet been paid and that one can

hardly tell, at this juncture, just how the currently uncashed claims arising out of gold purchases will eventually be used and what the output level of our economy will be at the time they are used, makes it extremely difficult to say how, and by whom, the cost will be borne and what effect will be revealed in living standards.

The above is not, however, an important defect of the argument. The volume is, in all, a closely reasoned one and the argument is, in all important respects, most convincing. It should be particularly helpful in college courses in international economic problems, although it does not pretend to present an elementary version of international currency issues.

R. J. SAULNIER

Columbia University

Marketing Burned-Clay Products, by A. Hamilton Chute. Columbus, Ohio: The Ohio State University. June, 1939. xx, 374 pp.

This book presents the detailed results of an intensive study of the marketing of burned-clay products, i.e., stoneware, dinnerware, sanitaryware, electrical porcelain, brick, structural tile, terra cotta, sewer pipe, and refractories. Much of the material for the report was collected through field work and by questionnaires during 1934 and 1935; some of the information is of more recent date. The study covers in a satisfactory way the marketing methods, policies, problems, and trends of burned-clay products in the United States, as well as the location of the industry and its place in American manufacturing.

The material in the report will be of interest to manufacturers and distributors of the products covered, and will be of value to teachers of marketing who wish a good example of the "commodity" approach to marketing. This study illustrates both the advantages and the disadvantages of this particular teaching device. The students, however, are likely to find the reading tedious and dull. Part of this is due to the nature of the subject matter. The author, by placing many of the census and other statistical data in an appendix, has increased the chances of getting the text material read. He has succeeded in establishing relative relationships by appropriate emphasis on the characteristics of the products, the methods of production, and of the demand. The resulting marketing functionaries and methods are clearly but briefly stated. One has the feeling, while reading the book, that here is a work that was laboriously and painstakingly prepared without much enthusiasm.

J. F. PYLE

Marquette University

Price Maintenance in Knoxville, Tennessee, under the Tennessee Fair Trade Act of 1937, by Charles W. Lewis. Knoxville: University of Tennessee. November, 1939. 64 pp.

The passage by more than forty States of so-called Fair Trade Acts and the recognition of their provisions in interstate commerce through the Miller-Tydings Act have led to general discussion of the Acts and their probable effects. On the other hand, Mr. Lewis makes a factual analysis based largely on interviews of 140 merchants out of a total of 414 in fifteen selected trades in Knoxville.

Approximately 66 per cent of the merchants interviewed either did not know of the Act or lacked knowledge of its essential idea, yet a majority believed legalized price control by the manufacturer was desirable. As might be supposed, opinion in favor of control was expressed most strongly in trades where price-cutting and competition from chains are prevalent. Although approximately 86 per cent of the merchants had signed no contracts, this is no indication of the number subject to control as the State law makes a contract signed by one dealer binding upon all others who have knowledge of it.

Price changes between January, 1937 (previous to the Act) and April, 1938, on one hundred items in the orthodox drug trade form the basis for the conclusions that there was only a 1.55 per cent decrease in the average price, and that only 13.8 per cent of the total number of price quotations declined. Although there is no statistical proof that minimum prices may have placed a floor under drug prices, the author is of the opinion, based on intangible factors, that manufacturers' prices are unlikely to be the actual prices. Furthermore, in spite of the fact that the average deviation shown for 18 items indicates slightly more increases than decreases since the Act went into effect, it is probably unwarranted to conclude that price competition has decreased.

Price changes in cut-rate drug stores were analyzed on the basis of newspaper advertising. The same periods were used as for the analysis of orthodox stores. Increases in the average aggregate prices of controlled goods as against decreases on non-controlled goods indicates the positive effect of the Act to increase prices in cut-rate drug stores—at least on nationally advertised, well-established products. It is also indicated that minimum prices tend to become maximum prices. From inadequate material, there is little evidence that the Act is having much effect on the merchandising policies of either orthodox or cut-rate drug stores.

Considerations regarding long-run effects of the Act are based largely on general economic reasoning and are little different from those commonly advanced by other writers. This study is a contribution in a field where there are too many generalizations based upon a priori reasoning.

AREND E. BOER

University of Pittsburgh

The Economics of Building, by Herbert W. Robinson. London: P. S. King & Son, Ltd. 1939. xii, 162 pp. 10*s*. 6*d*.

Mr. Robinson recognizes the difficulties in applying economic and statistical analysis to the building industry. He states "buildings are essentially heterogeneous—every building should be regarded as being different from all others." Also a diversity of workers and of functions in the industry, i.e. those of manual workers, contractors, speculative builders, investors, owner occupiers, and rent payers, contributes further elements of heterogeneity. Complex problems arise around the "need" for houses; the proportion of unoccupied houses; the relation between capital cost, repairs, and alterations and the life of buildings; demolition and replacement of buildings; etc. Because of the heterogeneity of the industry and the resulting problems, Mr. Robinson feels that it is necessary to adopt certain arbitrary classifications. Therefore, he uses the techniques of a stationary economy with its concomitant assumptions.

Then the element of dynamics is introduced by allowing each group of factors which influence building to vary, one group at a time, while the rest remain constant. Groups of factors given consideration are: demographic, such as the number of families, size of family, age and sex distribution and spatial movements of population; and economic, such as the demand and supply factors influencing buildings for occupation and for ownership. Mathematical formulae are used in the presentation and analysis of these data.

In addition to the above Mr. Robinson includes a statistical section for the purpose of testing the results of the theoretical analysis, forecasting the long-run tendency of residential buildings in the future, and explaining the extent of both residential, and factory and commercial building. He recognizes the limitations of the available quantitative data, and summarizes them as follow: the purposes for which the data were collected are not always comparable because definitions are changed to suit official needs; the areas covered by the statistics vary for different series and from time to time, introducing difficulties of comparability; and gaps in the data exist because some variables have not been measured. It will generally be conceded that the above constitute difficulties prevalent in many statistical analyses. The fundamental disadvantage, however, lies in the approach, i.e., what Mr. Robinson calls "macro-economic." His statistics are obtainable for large areas, such as England, Wales, or all Great Britain, whereas ideally to give recognition to the spatial differences stressed in the theoretical analysis the statistics should refer to small areas.

The conclusions contain the results from both the theoretical and statistical analyses. In summarizing the results of his analysis Mr. Robinson decides that a select few factors, "building need," business activity, rents, building costs, and the rate of interest determine the major part of building activity.

No reader can give this book even a cursory appraisal without recognizing that it is a well organized, clear, logical presentation. However, conclusions

based on the methodology of the static state have been criticized for years. The author forestalls these criticisms by justifying his use of the stationary state on the grounds that "if building activity problems were not simplified and we were plunged immediately into an analysis of a dynamic economy, it would be almost impossible to disentangle the demographic and economic factors involved."

In presenting the objectives of his analysis, the author may be credited with a little "wishful thinking." He suggests that speculative builders, estate agents, and architects might profitably apply some of the analytical and statistical techniques to their own local business problems. The question arises here, whether the majority of these persons have either the technical training, desire, or the time to use such techniques towards a solution of current difficulties. In other words, since the approach is primarily theoretical the greatest value of the book is probably to the students of economics and statistics.

ROSALIND TOUGH

Hunter College

The Economics of Business Enterprise, by Walter Rautenstrauch. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. 1939. xiv, 445 pp. $4.00.

The expectations aroused by the excellent title and some of the introductory statements in this book are unfortunately not fulfilled. It is suggested on page 2 that the subject matter will be the economic problems of specific business enterprises, with a statement of what is considered good practice, analysis of the theories underlying these practices, and development of methods for dealing with all such economic problems. Many business statisticians would regard a scholarly and realistic treatise along these lines as an exceedingly valuable contribution, in view of the tendency of most economic writings to take the view of political economy, with major emphasis on the governmental or international aspects of the problems, to the neglect of the needs of the individual corporation or business man.

As a matter of fact, however, the aim of the author is less comprehensive and less profound than the title might seem to imply. In the preface he himself suggests that a more appropriate title would have been "An Introductory Text on Some Economic Problems of Business Enterprise," and indicates that the subject matter covers about the area in which students in engineering and commerce will find themselves in the first few years after graduation. Moreover, the treatment omits almost entirely many important problems affecting individual enterprises, such as those concerned with marketing, price policy, transportation, and the reorganization of the capital structure. The general method of treatment, while often stimulating and helpful in stating conflicting points of view, fails to satisfy the needs of the mature reader for some kind of reconciliation of differences or judicial verdict based

on due consideration of all arguments. In fact, on certain points, the author does not seem to recognize the need for an integrated discussion and a decision on his part.

One instance of this failure on his part seems important enough to cite. On page 198, he mentions the opinion of some engineers that the undepreciated cost of the old machine should not be considered in determining whether or not a replacement machine should be purchased, but then reprints an article from "Machinery" which takes the opposite position. While he is well justified in presenting this article for the information of students who will have to meet that point of view when they go to work, it would seem essential for them to have the benefit of a comprehensive discussion of the principles involved, or at least a specific reference to "Studies in the Economics of Overhead Costs," written by the author's colleague, Professor J. M. Clark. A more general indication of the author's tendency to report rather than to decide is the fact that the book includes 15 extracts from other books and articles, amounting to about 78 pages. Naturally, some divergences of view between the author and these subsidiary authors remain unreconciled.

Subjects stressed by the author include the break-even chart and its application, costs, depreciation, economic worth of machines, materials and supplies, the interpretation of financial statements, growth curves, and a summary on "Business Enterprise on a National Scale." Conspicuously absent from the index are such statistical topics as probability, correlation, trend, variability, dispersion and error, and such economic and business management topics as competition, consumer demand, personnel, taxation, and forecast. In other words, the treatment is that of an engineer and college teacher, somewhat inadequately disguised by phraseology borrowed from economics. The author is apparently little interested in the statistical concepts which most of us would regard as essential for any thorough study of the Economics of Private Enterprise. In view of the paucity of good books in this field, this book will probably be helpful for reference purposes to many business statisticians, but should be considered as a starting point for further investigation rather than as authoritative.

ROBERT W. BURGESS

Western Electric Company

Capitalism the Creator, the Economic Foundations of Modern Industrial Society, by Carl Snyder. New York: The Macmillan Company. 1940. xii, 473 pp. $3.75.

This volume, dedicated to Adam Smith, may be thought of as a modern sequel to the Wealth of Nations. It represents the seasoned product of many years of wide reading, careful research, and profound thinking by one of the ablest social scientists of our day.

Here we have the reasons for the advance of modern civilization set forth boldly, with none of the half-hearted apologetic tone characterizing many of the recent defenses of the capitalistic system. Orthodox grammarians may object to the wide use in the book of phrases and clauses instead of sentences. Many persons will take exception to certain conclusions. Few, however, will read this work without being led to do considerable hard thinking about the basic principles underlying our economy.

The main thesis of the book may be summarized thus: The rate of advancement of any nation is determined primarily by the relative prevalence of inventive genius and the amount of wealth saved. Progress is due to the few and not to the many, depending more upon a handful of thinkers, inventors, and captains of industry than upon millions of the common people. Inventions and planning are, however, useless unless abundant capital is at hand to implement them, and capital is obtained primarily from profits and from the savings of that small fraction of the population possessed of great wealth. It follows that, in a competitive society, marked increases in the general welfare are practically impossible unless profits are large, and wealth is highly concentrated in the hands of the few. Furthermore, governmental control of industry is always so inefficient that one cannot expect high production or prosperity in any kind of socialistic or totalitarian state. All successful movements toward equality—that is in the direction of transferring wealth or income from the rich to the poor or from the citizens to the government—are therefore certain to impoverish all classes of the population.

The reason that, under free competition, wealth is so highly concentrated is that the ability to gain and retain wealth is made up of a combination of faculties, each of which is scarce. Naturally, it is extremely unusual for any individual to possess a combination of these rare faculties.

The author brings out the fact that, when governments or labor unions succeed in maintaining wages at artificially high levels, unemployment is the inevitable result. He also shows how attempts to relieve such idleness by doles of one kind or another have always pauperized the common people. He follows Adam Smith in holding that the economic salvation of every nation lies in freedom of enterprise and untrammeled competition, and that governmental regulation stifles progress. He contends, for example, that, at present, our transportation system would be far more advanced, and the nation would be more prosperous than it is today had there never been any regulation of the railways by Federal or State commissions.

In the opinion of the reviewer, the author's treatment of the business cycle is weakened by failure to take cognizance of the accumulating evidence that well-defined periodicity exists in the fluctuations of business. It appears also, that in some instances, he has made the mistake of giving credence to the canards circulated by muck-raking pseudo-biographers in their endeavors to belittle the achievements of distinguished men. The great majority of the statements and arguments in the book are, however, so well-supported by masses of evidence that it is difficult to doubt their validity.

Numerous well-constructed and highly informative charts are interspersed through the text. The style is simple, and the argument easy to follow. The book should be read by every citizen who desires to gain a clearer understanding of the fundamental causes of national prosperity and progress.

WILLFORD I. KING

New York University

Consumer Credit and Economic Stability, by Rolf Nugent. New York: Russell Sage Foundation. 1939. 420 pp. $3.00.

Years of tenacious searching, evaluation, and analysis of meager data, and effort at coordination of theory and evidence, have yielded a contribution to the field of consumer finance which all students of this pervasive but fugitive subject will welcome appreciatively. As an infant industry growing like Topsy, maturity was reached before many efforts at discipline were made or attention paid to its relation to the remainder of the social economy. Not until the postwar depression did some segments of the field appear to the commercial banker as a legitimate outlet for credit, and even then an improvement in the capital market was welcomed as a release from questionable business associations.

Rolf Nugent not alone makes available estimates of outstanding amounts of various categories of consumer credit for a period of fifteen years—an arduous task—but in addition he associates the fluctuations of aggregate consumer indebtedness with changes in the national income and interprets the relation of consumer credit to cyclical variations.

The first section of the tripartite division of the discussion is devoted to a history of consumer credit, including agencies and technique, from 1800 to 1938. In the second part is presented an estimate of the economic consequences of the fluctuations of consumer credit. Finally, a detailed description of sources of data and of methods of estimate is appended.

Based in general upon Keynes' theory of economic relationships under conditions of disequilibrium, but with "reluctant" modifications, Part II is a "dynamic" analysis of the place of consumer credit in our modern economy. Nugent considers his data "still too crude . . . to provide satisfactory verification" of the principles he develops, but believes his analysis "fully reconcilable with the data available" to him.

The author finds little evidence that the expansion of consumer credit represents a diversion of capital from other fields.

Of the three forms of consumer credit—deficit financing, income-period financing, and consumers' capital financing—the first moves inversely to the fluctuations of the business cycle, while the other two move directly, largely dependent upon changes in the volume of retail sales. The financing of durable goods currently dominates the aggregate movement. In a discussion of consumer credit in relation to fiscal policy, the author appears to maintain that a policy of public expenditure in 1931 would have cut short our depression.

Control of the financing of durable goods could be obtained, it is proposed,

by the manipulation of down payments and of periods of amortization of installment debts. Outstanding amounts could be stabilized by supervision, including the limitation of consumer paper held in bank portfolios.

The reviewer is not in accord with the author's position with respect to home-financing, particularly the readiness with which he classifies this important form of consumer finance under producer's investment, even though distinctions between buyer-occupancy and tenant-occupancy may be difficult to estimate. But perhaps in later studies Nugent will attack this problem with as much ingenuity as he has the more general problem.

John H. Cover

The University of Chicago

A Statistical Study of Credit Unions in New York, by Francis E. Wilcox. Chicago: The University of Chicago Press. 1940. ix, 91 pp. $1.00.

The author is a staff statistician of the Household Finance Corporation, a leading small loans company, and this study was undertaken because of the desire "to evaluate the operations of credit unions as competitors." The study was restricted to an analysis of available credit union statistics. An evaluation of the economic and social importance of credit unions was not attempted. Within his self-imposed limits the author has made a valuable contribution.

The New York State credit union law was first enacted in 1914. In that year two credit unions, with total assets of $6,000, were established. At the end of 1938 there were 166 state-chartered unions and 337 unions with Federal charters in the state. The former group had assets of $12,382,000, and the latter, $3,940,000. The combined membership of the 503 unions was 166,274. Despite such a rapid growth, which was particularly noticeable following the passage of the Federal Credit Union Act in 1934, total loans outstanding of the credit unions in the state were smaller, at the end of 1938, than the total loans outstanding of each of the four competing types of consumer finance institutions. Credit union loans outstanding amounted to just under $12,000,000 in comparison with $25,000,000 for the Provident Loan Society (pawnbroker), $45,000,000 for the industrial banks (Morris Plan type), $55,500,000 for the personal finance companies (licensed small loans lenders), and an estimated $58,000,000 for the personal loan departments of commercial banks.

More than one-half of the credit unions in the state were located in the New York City area. The occupational union, in which employment in the same business establishment, government unit, or educational system is the basis for membership, has in recent years become the predominant type. The open type, in which residence in the same community is the basis for membership, predominated in earlier years.

The rate of interest charged by credit unions on loans is limited by the laws in force in New York State to 1 per cent per month on the unpaid balance of the loan or, what is essentially the same rate, 6 per cent per annum discounted in advance. The author's investigations revealed that the major-

ity of the unions charged the maximum permitted rate. Unions of the occupational type tended to charge less than the maximum more frequently than did the unions of the open type. Newly organized unions usually showed a low ratio of borrowers to total members, but as the unions matured the ratio typically exceeded 50 per cent. The average amount of shares held per member varied widely among the individual unions but in a considerable number of the older unions the average shareholding was $83 at the close of 1937. Dividends paid on shares were most frequently at the rate of 6 per cent in 1937, although a considerable percentage of the unions paid less than 6 per cent.

JOSEPH L. SNIDER

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De Svenska Privatanställda, en Sociologisk Studie, by Fritz Croner. Stockholm: Kooperativa Förbundet Bokförlag. 1939. 474 pp. Kr. 12:-.

De Svenska Privatanställda is a statistical monographic study of the socio-economic characteristics and background of men and women employed in private industry together with their relation to the social system of Sweden. Dr. Fritz Croner and a staff of workers conducted the research and prepared the volume under the directorship of the late Dr. Sven Wicksell of the Statistical Institute of Lund University.

The volume is an ambitious work with some of the methodological characteristics of *American Business Leaders* by Taussig and Joslyn. The data for the volume were obtained from 7,337 questionnaires sent out to 38,000 privately employed persons who were earning less than 25,000 *Kroner* in 1936. The respondents consisted of 32 superintendents, 1242 technical administrators, 269 supervisors, 4,300 merchantile administrators, 65 watchmen and guards, 273 stockroom workers, 1,066 small shopkeepers and 90 pharmacists. These 7,337 (3.4 per cent) are taken as representative of the 202,100 privately employed persons in Sweden. Of the respondents 3 per cent were under 20 years of age, 38 per cent between 21 and 30, 33 per cent between 31 and 40 years, 17.5 per cent between 41 and 50 years, 7.2 per cent between 51 and 60 and 1.3 per cent were over 60 years of age. Of the men (5,618) 45.6 per cent were married and of the women (1,719) 89.6 per cent were single.

Median salaries in Swedish crowns

Work group	Men	Women
Superintendents	12,500	
Technical administrators	3,449	1,568
Supervisors	5,441	
Merchantile administrators	3,624	2,384
Watchmen and guards	2,644	1,802
Stockroom workers	2,972	1,672
Small shop keepers	2,621	1,986
Pharmacists	8,000	5,400

The salaries for all groups, except the supervisors, increased with age. Their salaries decreased after 42 years of age. In addition, the author examines salaries in relation to length of employment, types of work regions, community, size of enterprise, education, cost of living and mobility (within and outside Sweden). Salaries for all groups increased rapidly from 1914 (100) to 1921 (241) and then decreased to 1936 (158); food and clothing costs followed a similar course. Men who entered business enterprises between 1916 and 1926 received increases in salaries at a much faster rate than those who entered between 1926 and 1936. Salaries were positively correlated with travel, which was mainly to Germany. Salaries were higher for those working outside the country of their birth.

From salaries the author turns to "workhours" with reference to occupation, region, types of enterprise, overtime and pay. The net (total minus rest periods) hours per week varied from 43 to 50 hours and the number per day from 7 to 8 hours according to the enterprise. According to the law of 1936 each employee receives at least 12 days vacation each year. The statistics devoted to "turn-over," pensions, termination of employment and insurance programs are detailed to the point of minutiae and like other postions of the volume lack interpretation and comparative analysis.

In the second half (200 pages) of the book the author depicts the social background of the respondents with reference to educational attainment, social position of near relatives, class origin and social mobility, civil status, age at marriage, size of family, rents, and family budgets.

Of the 7,003 for which data were available 27.6 per cent came from the "independent entrepreneur" class, 14.1 per cent from "higher service" group 25.6 per cent from the "middle class," and 32.7 per cent from the "lower service class."[1] About a fourth of the respondents came from their own class. The social position of the younger group of respondents did not depend on the father's social status as much as did that of the older group. Social heritage, therefore, plays an important role in the prewar group but not in the postwar class. Contrariwise, educational attainment is more important for advancement for the younger generation than it was for the older men. Technical education contributed more to advancement than "higher school" education.

The median age at marriage was 29.1 years for men and 27.6 years for women. Of the 3,099 who gave information about the number of children, 33.4 per cent were childless, 33.1 per cent had one child, 20 per cent two, 7.9 per cent three and 5.6 per cent had four or more children.

After presenting a number of diagrammatic case histories in terms of occupational advancements, salary changes, age and family size, the author concludes with a brief treatment of socio-economic problems. Dr. Croner states that two serious problems confront the privately employed, (1) insecurity of income and employment and (2) the fact that they are an

[1] Because of differences in division of labor and social classes it is difficult to find adequate counterparts in American social structure for these terms.

inarticulate minority dependent on their employers. When and if these privately employed associate themselves with the organized artisans and labor groups they may obtain some security and stability of income and position. The methodological and analytical shortcomings of this volume are offset by its wealth of important statistical information.

WALTER A. LUNDEN

University of Pittsburgh

Labor in the United States, Basic Statistics for Social Security, by W. S. Woytinsky. New York: Social Science Research Council. A Report Prepared for the Committee on Social Security. 1938. xxii, 333 pp. $3.50.

This analysis of the basic statistics necessary for Social Security Administration, one of the studies of the Committee for Social Security of the Social Science Research Council, is addressed primarily to those interested in Social Security policy or charged with its administration, but the study will be most useful to all students of the American labor supply. Dr. Woytinsky's analysis had its inception in the fact that the occupational groups defined in the population census (with its emphasis upon occupation or kind of work) do not correspond to the groups specified in the Social Security Act. Particularly the lack of clear differentiation between employees, on the one hand, and self-employed and employers, on the other, and the unavailability from census reports, emphasizing classification on an occupational basis, of data on the size of establishments by industries have made imperative reclassification and retabulation of the occupational statistics. Dr. Woytinsky has accordingly extracted from the available census reports the data basic for Social Security administration, has combined his analyses of data available from the various other censuses—manufacturing, mines, agriculture, etc.—and has rearranged, tabulated, and critically interpreted the data.

Book I presents an analysis of the occupational statistics provided by the Census of Population, these being regarded as "statistics of the supply of labor." To ascertain the number of employers and employees and to distribute employees by industry, by class of work, by sex, by race and age, and by insured or non-insured status, the 1930 occupational statistics have been adjusted to the concepts deemed most necessary for Social Security administration. By the method of interpolation, age distribution by single-year classes and median ages of the various groups have been derived; evidence of the extent and character of horizontal (industrial affiliation) and vertical (class of work or economic status) shifts of the workers has been derived from revealed contrasts in age distribution among different groups; and present and prospective size of the groups on the "inactive" and "intermittently active" files of the Board has been estimated. In Book II the Federal statistics of industrial employment (regarded as the "demand for labor") are analyzed and adjusted to Social Security requirements. The

necessity to use alternatively the statistics from the two sources raises question of their comparability and of whether discrepancies between them can be reconciled; but Dr. Woytinsky's adjustment of the occupational and industrial statistics indicates close agreement between the two sources.

As Mr. Webbink observes in his Foreword, the estimates emerging from this detailed and careful study are subject to qualification; but all students of labor economics are indebted to Dr. Woytinsky for a rearrangement and interpretation of the census data that sheds appreciable light upon conditions of the labor market. Methodological discussions and interpretation of the available statistics, and suggested explanations of the revealed facts, are interwoven with the entire discussion.

Royal E. Montgomery

Cornell University

Old-Age Security, Social and Financial Trends, by Margaret Grant. New York: Social Science Research Council. A Report Prepared for the Committee on Social Security. 1939. xiii, 261 pp. $2.50.

In size, Margaret Grant's book is not at all typical of the heavy tomes usually put out by American research foundations. It is small, compact and without too many distracting footnotes. It is therefore all the more regrettable that it follows foundation products in cramming most valuable and illuminating facts of genuine immediate concern to the American public so tightly on every page as to repel all but those hardy researchers who have to write books on the subject. It is a long time since this reviewer encountered as much difficulty in perusing a book and he has not yet been able to develop sufficient misanthropy to recommend it to his students.

It is also unfortunate that this monograph was not published when the old age insurance question was a prominent political issue rather than after this part of the Social Security Act was radically revised. For its enlightening information would have proved invaluable in the four-year struggle to amend this part of the social security program. The exhaustive first-hand material regarding the background, history, and vicissitudes of the old age insurance systems in operation abroad for many decades would have helped immeasurably in shattering many American illusions about social security, shedding light upon many of the deepest confusions and misconceptions, and might have even spared the nation years of delusion.

Thus America might have been saved from the illusion of the $47,000,000,000 reserve in old age insurance if it knew that "every old age insurance scheme in Europe covering wage-earners generally has relied heavily on government financial participation." Our thinking might have been clearer if the country had been shown that old age insurance costs keep on rising for many years and that when they stop doing so something worse happens. The author's array of facts reveals that, whereas the cost of old age insurance increased 35 per cent in Sweden, 92 per cent in Great Britain and 224 per

cent in Czechoslovakia between 1930 and 1936, it decreased by 12 per cent in Germany.

Had the information supplied by Miss Grant been available before, American voters might also have been less tolerant of the political manipulations with old age pensions for they would have been aware that in European countries pension plans have been subjected to neither political manipulation nor pressure groups. Although in all countries the support of needy old persons by the community has been fully recognized for many years, no peddlers of cure-all schemes through pensions have developed there. Even our chase for Utopia might have slowed down if we knew that in Sweden, which some Americans have recently tried to paint as the land of Utopia, the average pensions "do not compare favorably with the benefits paid under the German and British old age insurance systems, nor do they approach the non-contributory pensions in Denmark, Great Britain, Australia and New Zealand."

As a source book for a factual, evolutionary study of old age pensions and insurance systems abroad, this book is invaluable and unequalled in the United States. Like all statistical sociologists, the author unfortunately suffers from a tendency toward over-simplification of social and economic forces and from an eagerness to reduce unmeasurable and uncontrollable social trends into statistical measurements. But this is a typical American disease.

ABRAHAM EPSTEIN

American Association for Social Security

Predicting Success or Failure in Marriage, by Ernest W. Burgess and Leonard S. Cottrell, Jr. New York: Prentice-Hall, Inc. 1939. xxiii, 472 pp. $3.25.

This is a statistical analysis whose objects are to develop a method of measuring success in marriage, to discover what factors present at the time of marriage are associated with marital success or failure, and to devise a method of predicting success or failure before marriage. The study relies chiefly upon questionnaires sent to 526 couples supplemented by semi-intensive case studies. Upon the basis of answer to questionnaires, marital adjustment scores are devised.

A recapitulation of the findings of this study shows the following: Wives make the major adjustment in marriage; affectional relationships of childhood condition the love life of the adult; socialization of the person as indicated by his participation in social life and social institutions is significant for adjustment in marriage. The economic factor in itself is not significant for adjustment in marriage. With the majority of couples social adjustment in marriage appears to be a resultant not so much of biological factors as of psychogenetic development and of cultural conditioning of attitudes toward sex. The final conclusion is that predictions before marriage of marital adjust-

ment is feasible and should and can be further developed through statistical and case study methods.

A possible criticism of the study is its attempt to draw mathematical conclusions from a body of material much of which is elusive and subjective. Facts are difficult to gather upon a subject so personal and intimate, and conclusions based upon doubtful and incomplete information are not convincing.

Agnes M. H. Byrnes

Hunter College

New Facts on Mental Disorders, Study of 89,190 Cases, by Neil A. Dayton. Springfield, Illinois: Charles C Thomas. 1940. xxxiv, 486 pp. $4.50.

This book represents an attempt to apply statistical procedures to the analysis of problems which have been elucidated in the past almost entirely by the case history. The relationship of age, nativity, alcoholism, economic status, and marital condition to the development of mental disorders is analyzed from information concerning admissions to mental hospitals in Massachusetts from 1917–1933. Only those who have attempted to utilize institutional records can fully appreciate the labor involved in collecting and verifying the basic data for this study.

It is unfortunate that the results of this investigation, which apparently was well planned and carefully carried out and which entailed a considerable amount of painstaking labor, have been invalidated by the use of faulty statistical techniques. Admission rates are computed on the basis of the number of admissions for 17 years and the population for one year. By including a sufficient number of years, an admission rate of unity could be obtained, thus showing that everyone in the population was insane.

The discovery that the majority of foreign-born patients aged 10–19 years had been in the United States less than 15 years while a majority of foreign-born patients aged 70 and over had been here more than 15 years is explained by changes in the kind of persons who migrated to this country at different periods and by variations in their ability to become adjusted to a strange culture. It seems fairly obvious that there must be a high correlation between the age of an immigrant and his length of residence in the United States.

Fluctuations in the admission rate are explained by social and economic changes which took place at the same time. Thus an increase in 1919 resulted from demobilization, a decrease in 1920 reflected the beneficial result of national prohibition, a rise in 1921 and 1922 was due to the increase in bootleg liquor and the postwar depression; corresponding explanations are advanced for the fluctuations in other years. Although it cannot be denied that these explanations may contain a grain of truth, it seems very unlikely that the knowledge of the causes of mental disorder will be greatly increased by this type of statistical analysis.

Rather than abandon the discussion of data for which no base population was available, the author draws many of his conclusions from a percentage distribution of the particular characteristics in question. But such a percentage distribution among the cases depends upon the distribution of the same characteristics in the total population. If the latter is unknown, no confidence can be placed in conclusions based solely upon the former.

There seems to be no inherent reason why statistical methods should not be useful in the study of mental disorders. It should be realized, however, that statistical methods, unlike case histories, cannot be chosen in a haphazard manner and that if valid inferences are to be drawn from statistical analyses, the techniques used must themselves be valid.

HAROLD F. DORN

United States Public Health Service

PUBLICATIONS RECEIVED*

AGRARIAN CHINA. Selected Source Materials from Chinese Authors, with Introduction by R. H. Tawney. Chicago: The University of Chicago Press. xviii, 258 pp. $2.50.

AMERICAN ASSOCIATION OF COLLEGIATE SCHOOLS OF BUSINESS. Proceedings of the 21st Annual Meeting. 1939. 215 pp. $1.25 (in paper).

BELL, SPURGEON. Productivity, Wages and National Income. Washington, D. C.: The Brookings Institution. 1940. xii, 344 pp. $3.00.

BIRTH CONTROL FEDERATION OF AMERICA. Tomorrow's Children, Proceedings of the First Southern Conference on. New York City. 1939. xii, 169 pp. 75 cents.

BLACHLY, FREDERICK F. and OATMAN, MIRIAM E. Federal Regulatory Action and Control. Washington, D. C.: The Brookings Institution. 1940. xviii, 356 pp. $3.00.

BLAKEY, ROY G. and GLADYS C. The Federal Income Tax. New York: Longmans, Green and Co. 1940. xvii, 640 pp. $7.50.

BRATT, ELMER C. Business Cycles and Forecasting. Chicago: Business Publications, Inc. Revised Edition, 1940. xvi, 814 pp. $4.00.

—— This Unbalanced World. New York: Harper & Brothers. 1940. x, 220 pp. $2.50.

BUCHANAN, NORMAN S. The Economics of Corporate Enterprise. New York: Henry Holt and Company. 1940. xvii, 483 pp. $3.25.

BYE, RAYMOND T. Critiques of Research in the Social Sciences: II. An Appraisal of Frederick C. Mills' *The Behavior of Prices*. New York City: Social Science Research Council. Bulletin 45. 1940. xix, 335 pp. $1.00.

COHEN, WILBUR J. Unemployment Insurance and Agricultural Labor in Great Britain. Washington, D. C.: Committee on Social Security, Social Science Research Council. Pamphlet Series Number 2. 1940. viii, 32 pp. 50 cents.

DAVIS, SHELBY CULLOM. America Faces the Forties. Philadelphia: Dorrance and Company. 1940. 283 pp. $2.75.

DAYTON, NEIL A. New Facts on Mental Disorders, Study of 89,190 Cases. Springfield, Illinois: Charles C. Thomas, Publisher. 1940. xxxiv, 486 pp. $4.50.

DICKINSON, FRANK G., and EAKIN, FRANZY. The Illinois Segment of the Nation's Economy for 1935: A Bookkeeping Picture. Urbana, Illinois: University of Illinois. 1940. 132 pp.

FOOD RESEARCH INSTITUTE. Physical Tests of Flour Quality, by C. H. Bailey. Stanford University, California: Wheat Studies of the Food Research Institute. Vol. XVI, No. 6. March, 1940. pp. 243–300. $1.25.

FORD, ROBERT S. and LANDERS, FRANK M. Local Government in Cheboygan County. Michigan Pamphlets No. 7. Ann Arbor, Michigan: University of Michigan Press. 1940. 28 pp. 10 cents.

GAVENS, HENRY. Shorter Hours—How? When? Washington, D. C.: Ransdell Incorporated. 1938. ix, 128 pp.

HARWOOD, E. C., and FOWLE, HELEN. How to Make Your Budget Balance. Cambridge, Massachusetts: American Institute for Economic Research. 1940. 143 pp. $1.00.

HOFFMANN, WALTHER. Wachstum und Wachstumsformen der englischen Industriewirtschaft von 1700 bis zur Gegenwart. Jena: Gustav Fischer. 1940. x, 284 pp. RM 16.

INTERNATIONAL SOCIAL INSURANCE CONFERENCE. XXIVth Session of

* Annual reports and publications presenting statistics collected at regular intervals have been omitted from this list. Some items of minor interest to statisticians have also been omitted. The contents of periodical publications are not listed, but the attention of the reader is directed to the lists of articles in current publications which are to be found in the *Revue de l'Institut International de Statistique*, *Journal of the Royal Statistical Society*, *American Economic Review*, *Population Index*, *Transactions of the Actuarial Society of America*, *The Record of the American Institute of Actuaries*, and *Sankhyā, The Indian Journal of Statistics*.—Editor.

the International Committee. Geneva: Palais Wilson. 1939. 76 pp.

JASNY, N. Competition among Grains. Stanford University, California: Food Research Institute. 1940. xiii, 606 pp. $4.00.

JEFFREYS, HAROLD. Theory of Probability. New York: Oxford University Press. 1939. vi, 380 pp. $7.00.

JONES, G. P. and POOLE, A. G. A Hundred Years of Economic Development in Great Britain. New York: The Macmillan Company. April, 1940. 420 pp. $4.50.

KOLLER, S. Graphische Tafeln zur Beurteilung statistischer Zahlen, Mit 6 Abbildungen und 15 Tafeln (darunter 4 Bildtafeln). Dresden und Leipzig: Theodor Steinkopff. 1940. 73 pp. (gebunden) RM 50.

LASORSA, GIOVANNI. Statistica Economica, con Riferimenti Alla Organizzazione e Alle Fonti. Cedam: Casa Editrice Dott. Antonio Milani. Padova: 1940. vii, 405 pp.

LEAGUE OF NATIONS. Balances of Payments, 1938. Geneva. New York: Columbia University Press. 1939. $1.25.

—— Raw Materials and Foodstuffs. Geneva. New York: Columbia University Press. 1940. 75 pp. 60 cents.

LINDQUIST, E. F. Statistical Analysis in Educational Research. Boston: Houghton Mifflin Company. 1940. xi, 266 pp. $3.00.

LOYO, GILBERTO. Evolucion de la Definicion de Estadistica. Tacubaya, D. F., Mexico: Instituto Panamericano de Geografía e Historia. Publicacion Num. 44. 1939. 77 pp.

MADDOX, WILLIAM P. European Plans for World Order. Philadelphia: The American Academy of Political and Social Science. 1940. 44 pp. 15 cents.

MALZBERG, BENJAMIN. Social and Biological Aspects of Mental Disease. Utica, New York: State Hospitals Press. 1940. iv, 360 pp. $2.50.

MICHIGAN, UNIVERSITY OF, BUREAU OF BUSINESS RESEARCH. Economic Relations with Latin America. Michigan Business Papers, Number 6. January, 1940. 75 pp. $1.00.

—— Bank Investments and Reserves. Michigan Business Papers, Number 8. Ann Arbor: 1940. 84 pp. $1.00.

—— Proceedings of the Fifteenth Annual Michigan Accounting Conference. Michigan Business Papers, Number 7. Ann Arbor: 1940. 56 pp. $1.00.

—— Bureau of Government. State Tax Administration. Michigan Pamphlets No. 6. 1940. 18 pp. 10 cents.

MORANT, G. M., and WELCH, B. L., Compilers. A Bibliography of the Statistical and Other Writings of Karl Pearson. London: Biometrika Office, University College. 1939. viii, 119 pp. 6/.–

NEBRASKA, UNIVERSITY OF, COLLEGE OF BUSINESS ADMINISTRATION. Selected Books on Business. Nebraska Studies in Business No. 43. February, 1939. 50 pp. 50 cents.

PATON, W. A., and LITTLETON, A. C. An Introduction to Corporate Accounting Standards. Chicago: American Accounting Association. Monograph No. 3. 1940. xii, 156 pp. $1.00.

PEARSON, E. S., Editor. Tracts for Computers No. XXIV: Tables of Random Sampling Numbers, by M. G. Kendall and B. Babington Smith. London: Biometrika Office, University College. 1939. x, 60 pp. 3*s*. 6*d*.

PFANNER, JOHN ADAMS, JR. A Statistical Study of the Drawing Power of Cities for Retail Trade. Studies in Business Administration, The School of Business, University of Chicago. Chicago: The University of Chicago Press. April, 1940. xii, 81 pp. $1.00.

ROBERT, PAUL. La politique d'isolement économique. Paris, France: Les Editions Domat-Montchrestien. 98 pp.

ROREM, C. RUFUS. Non-Profit Hospital Service Plans. Chicago: American Hospital Association. January, 1940. 130 pp.

SCHUT, M. J. Tinrestrictie en Tinprijs. Haarlem, Netherlands: De Erven F. Bohn, N.V. 1940. xii, 115 pp. fl. 1.50 (stitched).

Shotwell, James T. What Germany Forgot. New York: The Macmillan Company. 1940. vi, 152 pp. $1.50.

Snyder, Carl. Capitalism the Creator. New York: The Macmillan Company. 1940. xii, 473 pp. $3.75.

Social Planning Council of St. Louis. Community Resources Book of St. Louis and St. Louis County. Publications of the Research Department. St. Louis: Social Planning Council. February, 1940. cxx, 358 pp.

Southard, Frank A., with the collaboration of Philip F. Swart, Jr. and A. N. Gentes. Foreign Exchange Practice and Policy. New York: McGraw-Hill Book Company, Inc. 1940. ix, 215 pp. $2.50.

Special Libraries Association. Business and the Public Library, Steps in Successful Cooperation. Edited by Marian C. Manley. New York: Special Libraries Association. 1940. 83 pp. $2.00.

Spurr, William Alfred. Seasonal Variations in the Economic Activities of Japan. Lincoln, Nebraska: University of Nebraska. March, 1940. ix, 129 pp. (Cloth) $1.50.

Stead, William H., Shartle, Carroll L., and Associates. Occupational Counseling Techniques, Their Development and Application. New York: American Book Company. 1940. ix, 273 pp. $2.50.

Strauss, Frederick. The Composition of Gross Farm Income Since the Civil War. New York City: National Bureau of Economic Research. Bulletin 78. April 28, 1940. 24 pp. 25 cents.

Timoshenko, V. P., and Working, Holbrook. World Wheat Survey and Outlook January 1940. Stanford University, California: Food Research Institute. January, 1940. pp. 205–42. 75 cents.

Tintner, Gerhard. The Variate Difference Method. Bloomington, Indiana: Principia Press, Inc. 1940. xiii, 175 pp. $2.50.

United States Steel Corporation T.N.E.C. Papers. Comprising the Pamphlets and Charts Submitted by the United States Steel Corporation to the Temporary National Economic Committee. Three Volumes. New York City: U. S. Steel Corporation. 1940. Vol. I, 411 pp.; Vol. II, 191 pp.; Vol. III, 101 pp.

Woytinsky, W. S. Additional Workers and the Volume of Unemployment in the Depression. Washington, D. C.: Committee on Social Security, Social Science Research Council. Pamphlet Series Number 1. January, 1940. vii, 37 pp. 50 cents.

Government Publications

Department of Agriculture, Bureau of Agricultural Economics. Organization and Crop Production Practices on Grain Farms in Selected Areas of the Northern Great Plains, by R. S. Washburn. Farm Management Reports No. 2. December, 1939. 94 pp.

Department of Labor, Bureau of Labor Statistics. Money Disbursements of Wage Earners and Clerical Workers in Five Cities in the Pacific Region 1934–36, by Faith M. Williams and Alice C. Hanson. Bulletin No. 639. 1939. 358 pp. 35 cents.

—— Family Expenditure in New York City, 1935–36. Volume II: Family Expenditure, by A. D. H. Kaplan, Faith M. Williams, and Alice C. Hanson. Bulletin No. 643. 1939. 232 pp. 30 cents.

—— Family Income in Five New England Cities, 1935–36, Volume I, Family Income, by A. D. H. Kaplan, Faith M. Williams, and Dorothy McCamman. Bulletin No. 645. 351 pp. 35 cents.

—— Family Income in the Southeastern Region, 1935–36, Volume I, Family Income, by A. D. H. Kaplan, Faith M. Williams, and Jessie S. Bernard. Bulletin No. 647. 520 pp. 60 cents.

National Labor Relations Board. Written Trade Agreements in Collective Bargaining. Bulletin No. 4. Washington, D. C. 1940. xiv, 359 pp. 35 cents.

Securities and Exchange Commission. Survey of American Listed

Corporations, Reported Information on Selected Manufacturing Groups, Registrants with the Securities and Exchange Commission under the Securities Exchange Act of 1934 at June 30, 1939, Volume I. 1940. 289 pp.

—— Investment Trusts and Investment Companies. Part Three: Abuses and Deficiencies in the Organization and Operation of Investment Trusts and Investment Companies. Chapter VI: Accounting Practices and Reports to Stockholders Generally—Accounting Practices of the United Founders Corporation Group of Companies with a Description of Their Activities. Section II. Description of the Activities of the United Founders Corporation Group. 152 pp. Section III. Accounting Practices of the United Founders Corporation Group of Investment Companies. 262 pp. 1940. (Mimeographed.)

WORK PROJECTS ADMINISTRATION, DIVISION OF RESEARCH. Youth in Agricultural Villages, by Bruce L. Melvin and Elna N. Smith. Research Monograph XXI. 1940. xxi, 143 pp.

—— Index of Research Projects, Volume III. 1939. 243 pp.

—— National Research Project. Industrial Research and Changing Technology, by George Perazich and Philip M. Field. 1940. 81 pp.